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EDITORIAL

CITIZENS ONLY

ABOUT two years ago the Commissioner of Hospitals of New York City, ordered that only registered nurses who were citizens of this country, or who had their first papers, were to be employed in the municipal hospitals.

The argument advanced was that there were many nurses who were citizens, who were having a hard time making ends meet and our first duty was to our own. Nurses who were citizens of other countries, would have to rightfully step aside and give our own girls first chance.

In many quarters sharp criticism of this order found expression. At the time, we wrote the Commissioner asking if an exception could be made in the case of a nurse who for several years, had headed one of our divisions. We just felt things would "go to pot" without her in charge. But there were no exceptions to the rule and she departed. A new head nurse arrived who has been with us ever since, giving one hundred per cent satisfaction. The other nurse went home and, later, married.

Recently a leading article in the Saturday Evening Post reviewed working conditions abroad. Boiled down, we learned that in foreign countries their citizens get the jobs that are available. If an American held a position, he or she was dismissed and a citizen of that country filled the vacancy. Tough on Americans . . . but, we reflected, blood is thicker than water, and they look out for their own *first*.

Since the depression and unsettled economic and political conditions abroad, many foreign physicians, finding the going hard, resorted to the expedient of packing their grips and catching a boat for the United States. The laws regarding the medical practice act differ in the various States, and some foreigners got their license through the back door, some took State Board examinations, and not a few got sinecure teaching assignments which permitted them to practice. Many of these gentlemen remain with us about eight months

a year, skim the cream and then run back "home" for a holiday. We have permitted this condition to exist. We have welcomed these physicians but, on the other hand, their countries adopt the opposite system. As an example, have an American physician decide he will move to France and practice, and learn what he has to do before he will be permitted legally to open an office. Then compare their system with ours.

And so a bill (No. 1510), which has been introduced in the New York Assembly by Mr. Conway, is interesting. Briefly, this bill proposes that no one who is not an American citizen is to be permitted to take the New York State Board examinations for license to practice medicine. Merely indicating an intention of becoming a citizen, or having at some time taken his first papers prohibits one from applying for a license. To be eligible to take these examinations the applicant *must be a citizen.* As this is written no one knows the fate of this bill. But physicians in other States might do well to study this bill and keep an eye open for the results.

Maybe the time has come when we will cease being a dumping ground for physicians from far countries, who look upon ours as a land of honey and easy money. Maybe the time has come when some sort of a protective medical tariff is necessary.

Or, are we suffering from a form of hysteria, and wasting our apprehension on "the sweetness of the desert air"?

T. S. W.

William Bradley Coley
1862–1936

William Bradley Coley, eminent surgeon, long a member of the Editorial Board of this Journal, and a sincere friend, died April 16, 1936, at the age of seventy-four years, following an operation at the Hospital for Ruptured and Crippled, on whose staff he had served for the past forty-five years.

Doctor Coley was a delightful companion; he never grew old, nor did he lose his early enthusiasms, and his mind always looked into the future.

We of The American Journal of Surgery will miss him; American Surgery has lost one of its outstanding men.

T. S. W.

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POSTOPERATIVE ATELECTASIS

FREDERICK CHRISTOPHER, M.D., F.A.C.S.
Associate Professor of Surgery,
Northwestern University Medical School
Chief Surgeon, Evanston (Ill.) Hospital
EVANSTON, ILL.

AND JAMES M. SHAFFER, M.D.
Miami Valley Hospital
DAYTON, OHIO

THE occurrence of several cases of atelectasis following surgical operations at the Evanston Hospital during the last few months, coupled with the apparent rarity of the condition previous to this time has prompted the following study of postoperative pulmonary complications.

Wm. Pasteur[1] in 1890 was the first to describe atelectasis, calling attention to pulmonary collapse following diphtheria. In 1910 the first case of postoperative atelectasis was recognized clinically, also by Pasteur.[2] Scott,[3] in 1925, in a complete study of the literature found only 64 cases reported, these included cases which were not postoperative. Previously often mistermed postoperative or ether pneumonia, atelectasis has been recognized with increasing frequency since 1925 as a common pulmonary complication following operations, so that now it is variously estimated as comprising from 20 per cent to 70 per cent of all postoperative pulmonary complications.[4,5]

Atelectasis may be defined as the collapse of a lung or portion of a lung in such a manner that the affected portion contains little or no air and is greatly decreased in size. Most authorities, including Coryllos,[6] Mathes and Holman[7] and Bergh[8] consider inspissated secretion to be the primary cause, following the evidence presented by Jackson and Lee[9] and Elliot and Dingley.[10]

The mortality of atelectasis, per se, is low, but as Faulkner[11] points out, postoperative massive collapse is of more than academic interest because it may be complicated by either a bronchopneumonia or a labor pneumonia with fatal results. When precautionary measures are neglected or proper treatment is delayed, true pneumonia, pulmonary abscess or empyema may be the outcome.*

Eliason and McLaughlin[14] at the University of Pennsylvania Hospital have published recently the results of their observations on postoperative pulmonary complications. They found a total of 129 such complications following 8864 operations in ten years. Of these, 32 were cases of atelectasis.

At Evanston Hospital, a five year period extending from June 1930 to June 1935, was studied. Since an atelectasis card has been included in the files only during the past year, the cases were found only after searching through all other postoperative pulmonary complications, such as pneumonia, bronchitis, etc. A total of 12,494 operations under general and local anesthesia were performed during that five year period. The total number of pulmonary complications were 77. These were proportioned as shown in Table 1.

TABLE 1
POSTOPERATIVE PULMONARY COMPLICATIONS IN 12,494 OPERATIONS

	Cases	Per Cent
Bronchopneumonia	19	24.6
Pulmonary infarct and embolus	13	16.8
Lobar pneumonia	10	12.9
Bronchitis	10	12.9
Hypostatic pneumonia	9	11.7
Pleurisy and pleural effusion	8	10.3
Atelectasis	8	10.3

* Coryllos and Birnbaum even go so far as to claim that every case of pneumonia is preceded by an atelectasis. Head,[13] however, believes that there is none of the evidence presented by these authors in support of their theory which cannot be explained just as easily in simpler fashion.

To the 8 cases of postoperative atelectasis occurring during the five year period are added 2 cases which have occurred since June 1935, so that a total of 10 cases are included in the report. In one patient atelectasis occurred twice, once following appendectomy, the other following intestinal obstruction eight days later, thus the 10 cases are taken from nine patients.

The years in which these diagnoses were made are as shown in Table II.

TABLE II

	Cases
1930	1
1931	0
1932	0
1933	3
1934	1
1935	5

Three cases were in patients below ten years of age, 6 cases in patients between twenty and forty. Seven were in males, 3 in females.

TABLE III
AGE INCIDENCE

Years	Cases	Per Cent
0 to 10	3	30
10 to 20	1	10
20 to 30	2	20
30 to 40	4	40

TABLE IV
SEX

	Cases	Per Cent
Males	7	70
Females	3	30

Five cases followed appendectomies, one case followed each of the following: intestinal obstruction, cholecystectomy and appendectomy, gastrojejunostomy, defundectomy, and drainage of prostatic abscess. Worthy of note is that 80 per cent of the cases occurred following lower abdominal surgery, which is contrary to the findings of Head,[15] Eliason[16] and others, who claim that high abdominal operations are more frequently followed by atelectasis, due to the fact that these operations restrict the diaphragm more thus decreasing forceful respirations and concomitantly, vital capacity.

However, one important factor in the development of atelectasis would seem to be injury to those muscles which help force the air out in expiration. The obliques, most commonly cut in appendectomies and hernial repairs, play an important part as accessory muscles of respiration. Scott's[17] collection of all cases reported up to 1925 seems to support this, since of the 64 cases, 11 were hernias and 17 were appendectomies. These two operations led all others easily in frequency and together made up nearly half of the total number of cases.

This series of cases is hardly large enough to draw any conclusions as to the part that anesthesia plays in production of atelectasis. (Table v.) Brown[18] believes that spinal anesthesia predisposes to atelectasis, due to its marked depression of the respiratory center, not only during the operation itself but for a considerable period thereafter.

TABLE V
ANESTHESIA

	Cases	Per Cent
Ether	5	50
Ethylene	3	30
Spinal	1	10
N_2O	1	10

Premedication was morphine and atropine, or scopolamine. One case received atropine alone. (Table VI.)

TABLE VI
PREMEDICATION

	Cases	Per Cent
Morphine sulphate and atropine	6	60
Morphine sulphate and scopolamine	2	20
Atropine	1	10
Morphine sulphate	1	10

Atropine, of course, tends to thicken secretions, thus producing a condition which would seem to be favorable toward

the production of atelectasis. That it played only a minor part, if any, is indicated by the fact that 3 cases received no atropine at all.

In 60 per cent of the cases the operation consumed more than one hour; 40 per cent less than one hour; 50 per cent received intravenous therapy postoperatively, 50 per cent did not.

The onset in the majority of the cases was quite typical, 70 per cent of the cases occurring the first three postoperative days. (Table VII.)

TABLE VII
TIME OF ONSET

Postoperative day	Cases	Per Cent
1st	4	40
2nd	1	10
3rd	2	20
4th	1	10
Over 4 days	1	10
Date not known	1	10

The atelectasis was ushered in in most cases with a sharp rise in temperature followed within a period of hours by cyanosis, shortness of breath, pain in the chest and increase in respiratory rate and pulse. Very significant is the fact that in 8 cases a history of inability to raise mucus, expectoration or coughing, occurred before the onset of the atelectasis. The temperature, pulse and respiration curves are very typical, the sharp rise being noted in all but one case. (Figure 1.)

TABLE VIII
LUNG TISSUE INVOLVED

	Cases	Per Cent
Entire right side	1	10
Right lower lobe	7	70
Right middle lobe	1	10
Right upper lobe	1	10

Physical findings are difficult to analyze. Head[19] claims that if the typical signs of atelectasis are not present, we are not dealing with an atelectasis. On the contrary, Van Allen[20] claims that many cases of atelectasis are misdiagnosed because of a lack of pathognomonic signs, the physical findings being modified, or difficult to

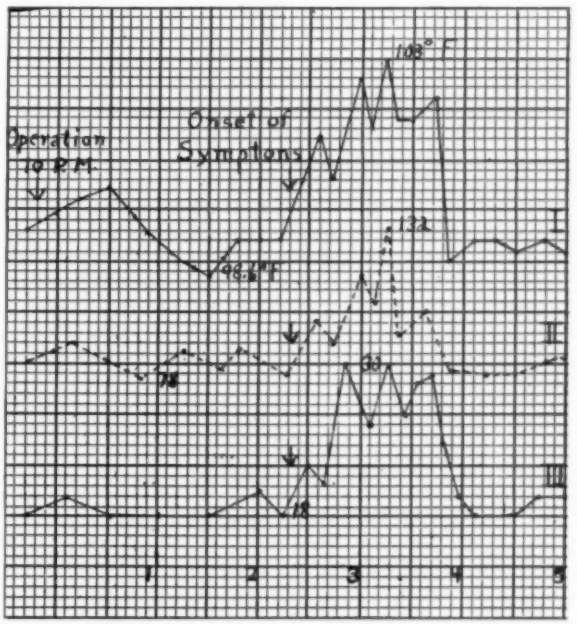

FIG. 1. Typical curves of temperature, pulse and respirations in a case of postoperative atelectasis. Vertical in graph I shows temperature in degrees Fahrenheit; in graph II, pulse rate per minute; in graph III, respirations per minute. Horizontal represents days postoperative. Case V. Typical of majority of cases.

ascertain, by the amount of surrounding normal lung tissue. The lung tissue affected is as shown in Table VIII.

Physical findings showed dulness to percussion in all cases over the affected area. Breath and voice sounds, which textbooks claim are always absent, were absent in 50 per cent of the cases, increased in 40 per cent and not charted in one case. As Scott[21] emphasizes, even when the breathing is largely suppressed there is often a bronchial quality to the sound that is heard. This factor easily gives rise to errors in physical diagnosis. Râles may or may not be present.

Restricted respiration on the affected side was noted in 3 cases on physical examination. In most of the cases no mention was made of observation of respiration or of a mediastinal shift. Sante[22] states that the mediastinum may remain undisturbed in the midline. The trachea alone may shift to the affected side. In

children, a scoliosis is a common finding, the concavity being directed toward the affected side.

The lack of uniformity in physical findings in so far as breath sounds are concerned demonstrates the importance of *x*-ray evidence. Nine of the cases were diagnosed as atelectasis by *x*-ray, one case had no *x*-ray. The importance of *x*-ray in diagnosis cannot be stressed too strongly. It is brought out clearly by Table IX, which is possibly the most instructive in the report. This table deals with the diagnosis made before *x*-ray findings.

TABLE IX
CLINICAL DIAGNOSIS MADE BEFORE *x*-RAY

	Cases
Not diagnosed	1
Atelectasis	3
(In only one case was a positive diagnosis made.)	
Bronchopneumonia	3
Postoperative pneumonia	1
Pleural effusion	1
Bronchitis	1
"Focus of infection"	1
Serofibrinous pleurisy	1

To summarize, a total of twelve diagnoses were made clinically, some cases receiving two diagnoses. A positive diagnosis of atelectasis was made in only one case. In 2 additional cases atelectasis was considered as a possibility. Thus in only one-fourth of the diagnoses was atelectasis even considered. This may well be contrasted to the statistics, quoted before, that 20 to 70 per cent of all pulmonary complications occurring postoperatively are atelectatic.

A history of upper respiratory tract infection preceding operation was found in 30 per cent of the cases, a high figure when the total number of operations is considered.

The atelectasis cleared the second day of its course in 50 per cent of the cases, while 80 per cent had cleared the third day. In almost every case relief came abruptly, with a fall in temperature and pulse rate to close to normal in a matter of several hours. Complete relief of symptoms, almost dramatic in character, was the rule. Coughing and expectoration of mucus usually continued for several days.

In one case, the atelectasis persisted until the day of discharge, the thirty-eighth postoperative day. Since it was discovered the day of discharge, no treatment had been instituted.

The frequency with which an incorrect diagnosis was made in these cases is perhaps paralleled by the diversity of treatment prescribed. Careful study of the records, including nurses' bedside notes, revealed that in only 3 cases was the type of treatment administered designed to correct the underlying cause. These 3 cases were relieved almost immediately and dramatically. Even after *x*-ray diagnosis was made, most treatment seemed to be directed toward controlling the cough.

From these statistical data presented, four important deductions may be made:

1. The clinical diagnosis is difficult.
2. Early *x*-ray examination in postoperative pulmonary complications is of first importance in making a diagnosis.
3. Proper prophylaxis definitely decreases the incidence of atelectasis.
4. The proper method of treatment is not commonly understood. When it is employed, the recovery is much more rapid.

1. *The clinical diagnosis is difficult.*

Nine additional cases were studied. These cases were chosen among the pulmonary complications as being most likely cases of atelectasis, but were not included in the report since neither a positive clinical nor *x*-ray diagnosis was made on them. In only one of them was atelectasis even considered in the differential diagnosis. They were diagnosed as shown by Table X.

TABLE X

	Cases
Bronchopneumonia	5
Lobar pneumonia	1
Hypostatic pneumonia	1
Pulmonary infarct	2
Bronchitis	1

Despite the diagnosis made on them clinically, atelectasis must be considered as a possibility in every case because of typical temperature, pulse and respiration curves and physical signs. In 6 of the 9 cases the

duration of the complication was less than forty-eight hours, with an abrupt rise and abrupt fall in temperature and pulse

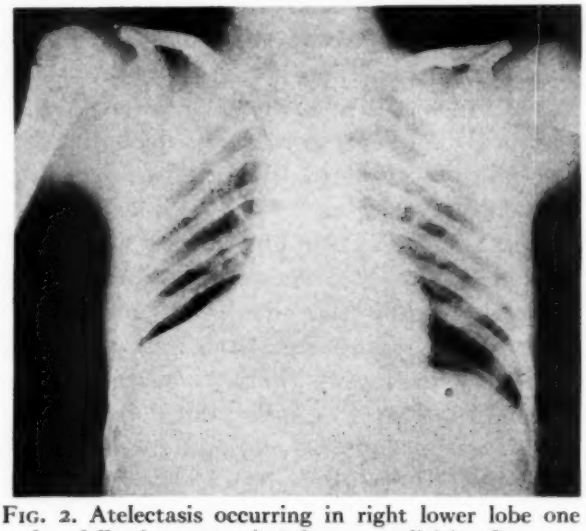

Fig. 2. Atelectasis occurring in right lower lobe one day following operation for appendicitis. Case III. No marked shift of mediastinal structures.

curves. Absent breath sounds were noted in 45 per cent of the cases. Mucus, postoperatively but previous to the onset of the complication was noted in 6 of the 9 cases. *X*-rays were taken in 6 cases, 2 of which were negative but were taken eighteen to twenty-six days postoperatively. In 2 cases, films were unsatisfactory, and the last 2 cases are possible atelectasis. (Crowder.[23])

The purpose of including these doubtful cases is not to prove necessarily that they are all errors in diagnosis, but to further demonstrate the important fact that atelectasis is not being considered often enough in the differential diagnosis of postoperative pulmonary complications. It is in diagnosing and treating early complications as cases of pneumonia, rather than as atelectasis, that the danger lies. (Faulkner.[24])

The onset and symptoms, according to Faulkner[25] may vary somewhat according to the suddenness in onset of bronchial plugging, size of plugged bronchus, alterations in intrapleural pressure and disturbance in position of mediastinal structures. Sante[26] claims that at times it is impossible to make a differential diagnosis between bronchopneumonia and atelectasis. This is true when a case of atelectasis has been allowed to continue for several days without proper treatment. The lung starts to expand, but atelectatic areas are still present, thus giving a condition simulating

Fig. 3. Atelectasis occurring on entire right side two days following operation for intestinal obstruction. Case IV. Mediastinal structures far to right.

bronchopneumonia closely both by physical findings and by *x*-ray.

II. *Early x-ray examination in postoperative pulmonary complications is of first importance in making a diagnosis.*

The *x-ray* findings are summarized by Sante[27] and Van Allen.[28] The half of the diaphragm on the affected side is elevated, the rib interspaces are narrowed, the mediastinal structures deviated to the affected side, and the lung tissue affected gives a homogenous shadow. (Figures II and III.) Sante[29] adds however, that when a single lobe alone is affected, such as the lower lobe, the heart and trachea may remain undisturbed in the midline, the space lost by atelectasis of a single lobe being taken up by a compensatory emphysema of the uninvolved portion of the lung. In children scoliosis is found often.

The fluoroscope frequently plays an important part in the diagnosis of an atelectasis, being of value chiefly in children due to the mobility of their mediastinum and their inability to cooperate. In one of our cases, the child could not be induced to hold his breath in

full inspiration, the resultant roentgenogram showed the heart and mediastinal structures exactly in the midline. Fluoroscopic examination however, showed these structures definitely move toward the affected side in inspiration.

In stressing the importance of *x*-ray findings, there is no intent to create the impression that physical findings are valueless or that a diagnosis cannot be made on the basis of physical findings alone. Such is not the case, although physical findings are definitely subordinate to the roentgen ray in a not inconsiderable proportion of cases.

III. *Proper prophylaxis definitely decreases the incidence of atelectasis.*

Prophylaxis is simple and should be standard in all hospitals. Deep breathing exercises for every postoperative case is desirable. Slow inspiration and expiration ten times per hour every waking hour. If the patient is not breathing deeply, carbon-dioxide oxygen inhalations two or three times every one-half hour should be added. No operation should be performed, except emergencies, when any condition predisposing to excessive secretion is present, e.g., sinusitis, laryngitis, bronchitis, etc. Faulkner[30] points out that atropine thickens secretions and should be used sparingly or not at all postoperatively. This view is shared by Alexander.[31] Brown[32] claims that the viscosity of the mucus determines whether a lobar or lobular atelectasis occurs, the more viscus mucus blocking off larger portions of the lung.

Stormy anesthesia predisposes to atelectasis. A patient on the table often becomes restless, vomits a little and the anesthetist may clamp a mask over his face. Crowder[33] believes foreign body from vomitus to be one of the common causes of atelectasis. The pharynx, during anesthesia, must be kept clear of excess mucus by aspiration.

Postoperative medication should be given carefully. Morphine depresses the cough reflex. However it also diminishes the pain on respiration thus allowing the lungs to get better ventilation and increase the vital capacity. Thus a happy medium, where the cough reflex is maintained, should be desired. The patient must be urged to cough. KI and NH_4Cl by reducing tenacious sputum, are useful drugs postoperatively. Dehydration plays a part in the production of atelectasis postoperatively by making secretions thicken, thus tending to form mucus plugs.

Posture is extremely important. The Trendelenburg position is indicated in every patient who has had an upper respiratory tract infection previous to operation, who has had a stormy anesthesia, or who is raising large quantities of mucus postoperatively, unless it is contraindicated by the surgical condition, as in peritonitis. All patients should have their positions changed frequently the first few postoperative days. Distention of the bowel or stomach, because it tends to elevate the diaphragm, should be relieved.

Binders put on abdominal wounds so tightly as to affect respiration reduce the vital capacity of the lungs and tend to hypoventilation, one of the predisposing causes of atelectasis.

IV. *The proper method of treatment is not commonly understood. When it is employed, the recovery is much more rapid.*

After the condition has been established, actual treatment is simple and gives dramatic results. Head[34] tells of a case occurring in a week old infant, wherein the treatment consisted only of turning the baby in an effort to examine the back. This change in position caused the infant to cough up a large quantity of mucus. A few whiffs of CO_4-O_2 were then given in addition. The child was better almost immediately.

The patient should lie on the uninvolved side, rolled back and forth and urged to cough. Sometimes slapping the affected side, which is uppermost, is of value. Sedatives which diminish the cough reflex should be reduced to a minimum and breathing exercises should be instituted, plus CO_2 inhalations. If these simple but effective methods of treatment do not give

relief, resort must be made to bronchoscopy. An oxygen tent is sometimes of value.

The question of lobular, or focal atelectasis has not been discussed fully in this report. Eliason and McLaughlin[35] in their report of 30 cases had 18 lobar and 12 lobular. There is a very strong possibility that some of the 9 cases discussed in this report as doubtful were lobular atelectasis. Van Allen[36] claims that the majority of cases of postoperative atelectasis are of the focal or lobular form, and Brown[37] seems to have demonstrated quite definitely, both by iodized sputum injection in animals and bronchoscopic examination of clinical cases, the existence and mechanism of production of scattered lobular atelectasis. The similarity between lobular atelectasis and bronchopneumonia, both by physical and roentgenological findings, may lead to treatment for bronchopneumonia if careful diagnosis is not made. To treat atelectasis as true pneumonia may rob the patient of his chance for recovery.

If there is any doubt about the consolidation being due to lobar pneumonia, bronchopneumonia, pulmonary infarct, pleurisy with effusion, etc., a safe procedure which often establishes the diagnosis is to roll the patient upon his uninvolved side and urge him to cough.

SUMMARY

1. The clinical diagnosis is difficult and is seldomly made; the *x*-ray diagnosis is generally easy. The importance of early *x*-ray examination of all postoperative pulmonary complications is indicated.

2. Atelectasis probably occurs far more frequently postoperatively than is suspected.

3. Proper prophylactic treatment decreases the incidence of atelectasis.

4. The proper methods of treatment will greatly accelerate recovery.

5. A report of 10 cases of atelectasis occurring postoperatively is presented.

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DIAPHRAGMATIC HERNIA*

ITS VARIETIES AND SURGICAL TREATMENT OF HIATUS TYPE

P. E. TRUESDALE, M.D., F.A.C.S.

Surgeon, Truesdale Hospital

FALL RIVER, MASSACHUSETTS

A REVIEW of the literature on diaphragmatic hernia discloses the controversial state of the subject. A more general understanding of the condition is important because of its disturbing influence on vital functions of the body.

At present the term diaphragmatic hernia appears to include every variety which occurs from birth to old age; therefore our present viewpoint on the various manifestations of this deformity needs to be clarified. Under the general title one author reports a series of cases entirely different from that of another who labors with his manuscript under the same caption. For example, diaphragmatic hernia in the newborn differs materially from that observed in children. Fundamentally and in many of the essential elements it varies from that encountered in later adult life. The only similarity between diaphragmatic hernia in the young and in the old is that each has a hollow viscus, or part of a hollow viscus, above the diaphragm. When the individual is at the meridian of life or later, the hernia is almost invariably of the hiatus type, not of congenital origin but acquired from a weak and gradually stretching musculature of the crura. In this, the most common form, we usually find the cardiac portion of the stomach protruding upward into the mediastinum through the relaxed pillars. By this process the peritoneum is pushed upward and forms a sac. Thus is developed a *hernia diaphragmatica vera* or true hernia. It is quite unlike the type of hernia found in children which develops through a deficiency not at the esophageal hiatus.

In this latter variety the important organs transposed are hollow viscera, including stomach, small intestine, and colon; the solid structures often herniated are the left lobe of the liver, the spleen and occasionally the pancreas. Grulee[1] stated that in this congenital type of hernia all the abdominal organs except the bladder, rectum and the genitalia have been found above the diaphragm.

Various classifications of diaphragmatic hernia have been set forth according to origin or location. Most authors use the classification of congenital, acquired or traumatic, based on the etiology, and true or false, with or without a sac. No classification presented thus far, however, appears to have served as a working basis of distinction in the bizarre manifestations of diaphragmatic hernia. This is not surprising, for it is now generally assumed that most hernias of the diaphragm have a congenital background and since the origin is due to a developmental defect, any form of irregularity may exist.

Although hiatus hernia often causes considerable disturbance to respiration, circulation, deglutition and digestion, it rarely terminates fatally. On the contrary, the type of hernia found in children often causes sudden death at birth or in the early weeks or months of life. Such deaths are so frequently ascribed to congenital heart disease or to enlarged thymus as to justify the attitude that in these cases opinion without postmortem evidence is unreliable. When autopsies on infants and

* Williamsburgh Medical Society, Brooklyn, November 11, 1935.

children are frequently done, more accurate figures on the incidence of congenital diaphragmatic hernia will be available. In over half the cases recorded, the children were stillborn or died shortly after birth from strangulation of the herniated viscera, acute dilatation of the stomach or asphyxia. Those who lived to reach adolescence suffered alterations of vital functions which were a constant threat to life. Symptoms resulting from the volume of transposed viscera varied in severity according to the degree of obstruction, torsion or intrathoracic pressure caused by the distention of the two gasbags, the stomach and colon.

Rarely an individual with diaphragmatic hernia lives to old age apparently unmolested, for by some chance the organs do not become obstructed. The structures in the thorax gradually become accommodated to the herniated viscera without causing embarrassment. In 1933 Jungfer[2] reported one of these cases in a man sixty-five years old. In the hernial sac resting above the diaphragm were the stomach and most of the omentum rolled into a ball, having herniated through the enlarged esophageal hiatus. Careful examination of the muscle fibers in the region of the hiatus showed structural weakness on the left side. The esophagus measured only 17 cm. Jungfer believed that this was a true esophageal hiatus hernia acquired early in life; the stomach entered the chest very early and since there was no traction on the esophagus it remained short.

In Bailey's[3] famous case reported in 1919 the man lived to be seventy-seven years old with no serious illness. The condition of the herniated stomach was revealed at autopsy.

In 1935 we reported a case seen at the Rhode Island Hospital.[4] The patient, a male fifty-eight years old, died from a strangulated inguinal hernia reduced *en bloc*. He had no complaints to suggest the presence of diaphragmatic hernia. At autopsy the entire stomach and omentum were found occupying a paramedial position in the right thoracic cage.

It is interesting to note that in these rare cases herniation occurs through the esophageal hiatus and the stomach is usually the only organ involved. Thus, if the stomach passes through the hiatus without becoming constricted and the diaphragm maintains its usual rhythmic movement, and if the crura do not impinge upon the cardiac portion of the stomach, this organ may remain in the chest throughout life without causing symptoms.

Even in the traumatic cases, symptoms often do not arise until years after injury. In Blum's[5] case, reported in 1896, symptoms arose eight years later; in Tatarinow's,[6] 1906, four years later; in Cranwell's[7] and Patel's,[8] 1908, several years later; in Grange's,[9] 1916, four years later, and in Polson's,[10] 1930, sixteen years later. In such cases, no doubt, certain changes occur in the hernia of a nature severe enough to impel the patient to seek relief.

In the congenital cases affecting children there were a few in which the condition was quiescent for many years. Newcomet's[11] nineteen-year-old athlete is a classic example. He did not complain of symptoms until he was seventeen, and two years later the condition was revealed by *x*-ray examination. Ager's[12] patient, a boy nineteen years old, died with the incorrect diagnosis of lobar pneumonia. Autopsy revealed the spleen twisted on its pedicle and fourteen inches of colon in the left chest. Keith's[13] patient lived to be nineteen before symptoms became at all troublesome, although it was known that the stomach had been in the right chest for seventeen years.

The presence or absence of a sac does not necessarily explain whether the hernia is congenital or acquired. Those through the foramen of Bochdalek[14] formed in early fetal life before the folds of pleura and peritoneum are present, are without a sac. In 1853 Bowditch[15] pointed out the fact that the right-sided congenital hernias almost invariably develop with a complete

sac, whereas those on the left usually have no sac. He showed also that hernia occurs more frequently on the left side, because the liver acts as a bulwark on the right; also the right crus of the diaphragm is longer and thicker and there are two fibrous bands on the right side which do not exist on the left. In any type a sac may or may not be present; about 90 per cent of those found in infancy and childhood are without a sac; in esophageal hiatus hernia we expect to find a sac.

Even the esophageal hiatus type of hernia admits of wide variation. For example, Makkas[16] described this condition in a man fifty-one years old. The *x*-ray film showed part of the stomach in the left chest and part in the right. At laparotomy a huge stomach was discovered in the chest, the diaphragm had lost all its convexity and the hernia sac was double, the heart resting on the diaphragm between the two sacs. The aperture at the hiatus was the size of a man's fist. The thorax contained the upside-down stomach, omentum and part of the transverse colon. A gastrojejunostomy was done but the patient died shortly after operation. Other complex cases have been reported with inverted and multilocular stomachs herniated through the esophageal hiatus.

It is evident, therefore, that the etiological background of this anomaly is so involved that all its manifestations are not easy to interpret. Like many other congenital defects, it opens up a vast field for conjecture.

The essential differences between hernia of the diaphragm in children and that observed in adult life are summarized in the following plan of classification. (Table 1.)

The two groups show a vast difference as to age, origin, location, amount of gastrointestinal tract transposed, solid viscera involved and symptomatology. They should be so differentiated when discussing the incidence of diaphragmatic hernia.

Few cases of congenital diaphragmatic hernia in children are reported. After a thorough search of the literature we discovered 303 cases, 165 of which were revealed at autopsy.[17]

TABLE 1
DIAPHRAGMATIC HERNIA
(Criteria of Differentiation)

In Children	In Adults
Development	
Congenital	Slowly acquired
Other anomalies present	No other anomalies
False (without sac) 90 per cent	True (with sac)
G-I tract involved	Gastric cardia usually
Lung collapsed	Lung normal
Dextrocardia	Heart in normal position
Esophagus deflected	Esophagus contorted
Stomach inverted	Stomach upright
Extensive adhesions	Localized adhesions
Anatomy and Pathology	
Underdeveloped	Well developed
Undernourished	Often obese
Pigeon-breasted, funnel chest, rachitic rosary	Normal chest
Barrel chest	Broad habitus
Scaphoid abdomen	Normal abdomen
Poor posture	Normal posture
Esophagus normal length	Short esophagus
Symptoms and Morbidity	
Hemorrhage uncommon	Anemia, hemorrhage
No erosions	Erosion, ulcer, cancer
Intestinal obstruction	Obstruction rare
Cyanosis common	Cyanosis rare
Convulsions frequent	Not observed
Cough simulating pertussis	Cough rare
Physical signs simulate tuberculosis	Physical signs simulate cholecystitis, ulcer, cardiac embarrassment
Dilatation of stomach common	Rare
Operation imperative	Operation elective
Operative mortality 40–50 per cent	Operative mortality 5–10 per cent
Asphyxia most common cause of death	Asphyxia not a factor

On the other hand, numerous articles have appeared describing the esophageal hiatus hernia in adults. As early as 1896, Arnheim[18] reported a case of this type. The patient, aged thirty-two years, died of pneumonia and the hernia was found at postmortem examination. In 1903, Andrew[19] discovered a case which he described as diverticulum of the cardiac

end of the stomach. In 1908, Arnsparger[20] affirmed that from the time of Ambroise Paré's[21] traumatic case reported in 1610 not more than 10 cases of diaphragmatic hernia in any form had been recognized off the dissecting table. At first the small hernias were difficult to demonstrate in a roentgenogram. Faced with negative *x*-ray evidence to account for symptoms which simulated ulcer, cancer or gall-bladder disease, the roentgenologist finally came upon hernia of the diaphragm which, as late as 1924, had been discovered at the Mayo Clinic in any form only once in 18,000 examinations.[22] Now roentgenologists are more alert in searching for this deformity and more successful in finding it.

In 1924 and 1925, Healy,[23] Morrison,[24] LeWald,[25] and Carman and Fineman[22] reported their observations on hiatus hernia. In 1926 Akerlund[26] published a monograph describing three types of hernia which might occur through the esophageal hiatus: (1) that due to congenitally short esophagus; (2) the paraesophageal type in which a portion of the stomach herniates through the hiatus beside an esophagus of normal length; and (3) the type in which the lower end of the esophagus and more or less of the stomach herniate through the opening.

Anatomic studies of hiatus hernia together with results from medical and surgical treatment have been recorded by many authors.[27–50] A review of the works of these writers indicates the wide range of opinions expressed on all phases of the subject, the diversity of viewpoints and the lack of agreement as to the method of classification, interpretation of *x*-ray films and treatment.

Sauerbruch[51] represents one group which does not accept as true hernias Akerlund's third class of hiatus hernias. Von Bergmann[49] calls the condition the "epiphrenal syndrome" or *Traktionsluxation*. The condition is not a true hernia but hiatal insufficiency resulting from a minor loss of tone in the muscular portions of the crura of the diaphragm. Von Bergmann found this condition the sole explanation for epigastric pain, vertigo and anginoid symptoms in patients considered neurotics. He ascribed these symptoms to irritation of the vagus nerves which run through the hiatus and to ampullary changes in the lower esophagus. His pupils introduced balloons into the lower esophagus in dogs and by inflation produced a strong retardation of the coronary circulation and symptoms simulating angina pectoris. Thus it is apparent that in this anatomic region many reflexes are possible. Rigler and Eneboe[44] found hiatus hernia in many instances in pregnant women. Anders and Bahrmann[28] after studying 48 anatomical specimens demonstrated the increasing frequency of the condition with advancing age.

In many cases the hiatus hernia is not demonstrable until the patient has assumed a prone position. For this reason Sauerbruch rejected many cases diagnosed as hiatus hernias, considering the condition merely a weakness of the hiatus which permitted the lower end of the esophagus to be drawn up into the thorax where it became dilated or bell-shaped. He stated that when the esophagus was filled from above, a shadow was visible but it was not that of the stomach; it did not appear when the esophagus was empty even when pressure was applied to the abdomen and the patient asked to strain. Anders rejected all hiatus hernias if a sac were not present.

From many examinations during laparotomy it has been found that the muscular limits of the hiatus vary widely in normal people, and that this variation has no bearing on the origin of the hernia. In our examination of the hiatus in more than 200 laparotomies we have observed that the aperture opens and closes with respiration. There is a definite pinchcock action described by Hurst,[36] Bársony,[29] and others. When hernia exists at the hiatus there is an abnormal degree of separation made usually by a greater relaxation on the part of the musculature on the left side; Hurst and Dunhill[52]

state that in these cases the left crus has failed to develop. *If so, hiatus hernia should appear soon after birth.* We believe that the origin of hiatus hernia is in the musculature which has lost its tone, has become insufficient and yields to constant transcursion on the part of the cardiac end of the stomach.

TABLE II
10 MEDICAL CASES OF HIATUS HERNIA

Date	Sex	Age	Contents of Hernia Seen on *X*-ray	Duration Symptoms	Symptoms	Remarks
1929	F	54	Cardia	5 years	Dyspnoea, vomiting	Anemia; on diet
1930	M	67	⅔ of stomach	years	Precordial pain, vomiting, jaundice	Died in 6 months; carcinoma of pancreas
1932	F	58	⅔ of stomach	4 years	Palpitation, pain in left chest	Anemia; on diet; treated for heart trouble for years
1932	F	56	Upper loculus of hour-glass stomach	2 years	Indigestion, epigastric pain, cardiac symptoms	Anemia; on diet; ? ca. of stomach
1932	F	66	Cardia, part of fundus of stomach	10 years	Dyspnoea, fatigue, cardiac symptoms	Anemia; heart disease; ? gastro-intestinal malignancy
1933	F	77	Cardia, part of fundus of stomach	7 years	Epigastric pain, weakness	Cholecystectomy; symptoms persist; on diet
1933	F	74	⅔ of stomach	years	Vomiting, epigastric pain	Died 2 weeks later; no autopsy
1934	M	78	Cardia, "gastrocele"	years	Vomiting, chills, constipation, dyspnea	Heart disease; operation for empyema of gall bladder; hernia not cause of symptoms
1934	F	42	Cardia, part of fundus of stomach	2 years	Cardiac symptoms, dyspnea, epigastric pain	Supravaginal hysterectomy for fibroids; hernia not repaired
1935	F	58	Cardia	9 years	Palpitation, dysphagia, anginoid symptoms	Anemia; on diet; myocardial disease

TREATMENT

Treatment in these cases of esophageal hiatus hernia is still a subject of controversy. Anderson,[27] LeWald,[25] Fineman and Carman,[22] Koppenstein[53] consider operation contraindicated if the esophagus is short. Richardson,[54] Morrison[24] and Bock[31] represent a group reluctant to operate even in the face of serious symptoms. Ritvo[55] found 60 cases in 8000 gastrointestinal series at the Boston City Hospital and operated upon three. He concluded that relatively few hiatal hernias require surgery. Gardner[56] and Harrington,[34] however, report marked improvement after operation. Symptoms disappear and there is often a rise in hemoglobin of 30 to 40 per cent. Further study will determine where medical treatment should end and surgical treatment begin. Failure to achieve cure by operation may be due to unusual findings or to faulty technique. Nissen[57] found surgery discouraging in these cases because the stitches pulled out and the crura separated. Richardson reported failure in two attempts to suture the hiatus.

Table II and Table III demonstrate cardinal symptoms in 28 cases of hiatus hernia, 10 medical and 18 surgical. The

Table III
18 surgical cases of hiatus hernia

Date	Age	Sex	Size of Hiatus by *X*-ray	Contents Herniated	Complications	Operation	Result*
1929	52	F	3 fingers	½ of stomach	Adhesions to sac, pericardium	Thoracic	Recovered
1930	52	F	3–4 fingers	Cardia	Ulcer, adhesions	Abdominal thoracic	Recurred in 4 years: ? carcinoma
1933	48	F	12 cm.	Hour-glass stomach	Stomach incarcerated, adhesions	Thoracic	Recovered
1933	43	F	3 fingers	⅓ stomach ? short esophagus	Diverticulum; heart disease	Thoracic	Improved
1934	48	F	3–4 fingers	7 cm. of stomach	Adhesions; dilated veins	Thoracic	Recovered
1934	65	M	4 cm.	7 cm. of stomach	Adhesions; bronchopneumonia	Thoracic	Recovered
1935	52	F	4–5 fingers	7 cm. of stomach	Stricture of esophagus, benign	Abdominal	Improved; bougie passed at times
1935	38	F	2 fingers	3 cm. of stomach	.....	Abdominal	Recovered
1935	48	F	Small inconstant hernia	.....	Eventration; phrenicotomy, 1 yr. previously	Thoracic	Plication of diaphragm; recovered
1935	52	F	4 fingers	8 cm. of stomach	Adhesions	Abdominal	Died; acute mediastinitis
1935	51	F	3–4 fingers	7 cm. of stomach	Old healed ulcer; adhesions	Abdominal	Recovered
1935	39	F	4 fingers	7 cm. of stomach	Adhesions to gall bladder	Abdominal	Improved
1935	55	M	4 fingers	5 cm. of stomach, ventral hernia	Colon, stomach adherent to diaphragm	Abdominal; repair of ventral hernia	Recovered
1935	63	F	3 fingers	5 cm. of stomach	Adhesions; diverticula, colon; hemorrhoids	Abdominal; hemorrhoidectomy	Recovered
1935	63	M	3 fingers	8 cm. of stomach	Short esophagus; inguinal hernia	Abdominal	Recovered
1935	46	F	4 fingers	Stomach, transverse colon in right chest	No mediastinum; dense adhesions	Thoracic	Died; acute mediastinitis
1935	52	F	3–4 fingers	Stomach upside-down, omentum in huge sac	Volvulus of stomach at pylorus, obstruction; dense adhesions	Thoracic	Recovered
1936	48	F	3 fingers	8 cm. of stomach	Adhesions to lung and diaphragm	Thoracic	Recovered

* Of these patients 16 recovered, 2 died, 4 were discharged improved. One patient has a stricture of the esophagus and returns to have bougie passed. In one case symptoms did not recur for four years, then *x*-ray revealed a probable carcinoma at the cardia. Two other patients still complain of mild symptoms. In 4 of the cases *x*-ray examination ten days after operation revealed a small portion of the cardiac end of the stomach above the diaphragm; the hiatus was smaller and symptoms have not recurred. The remainder have fully recovered.

series of adults comprised 5 males and 23 females. The average age was fifty-five years. These patients gave a history of long periods of epigastric distress, bloating, belching, nausea and vomiting, symptoms which were not relieved by alkalies, laxatives or enemata; anginoid pain sometimes completely masked the condition and was interpreted as due to myocardial damage. In 17 of the 28 cases the following diagnoses had been made before the patients were admitted:

TABLE IV

Diagnosis	*No. Cases*
Cholecystitis	8
Peptic ulcer	5
Mediastinal tumor	1
Carcinoma of stomach	1
Myocardial damage	1
Angina pectoris	1

In the remaining 11 cases hiatus hernia was suspected by the examiner and confirmed by the *x*-ray film.

Complications included ulcer of the stomach, benign stricture of the esophagus (2 cases), diverticula of esophagus and colon, ventral hernia, carcinoma of the pancreas, epithelioma of the face, fibroid uterus, myocarditis and bronchopneumonia. In one case treated medically a small portion of the cardiac end of the stomach protruded above the level of the hiatus taking the peritoneum with it but not developing a sac. This condition was more in the nature of a gastrocele. The patient, a man seventy-eight years old, complained of severe epigastric pain, vomiting, dyspnea and chills. An electrocardiographic tracing revealed myocardial disease; therefore operation was not done but a bland diet was prescribed and his condition improved. Six months later he returned with an acute abdomen, and a laparotomy on June 24, 1935, revealed empyema of the gall bladder. After a cholecystostomy his symptoms subsided and have not recurred. It is apparent that the complaints of this patient were due to the empyema of the gall bladder and not to the condition at the esophageal hiatus. He should have had a cholecystogram at the time of the first admission. Thus when a minor insufficiency exists at the hiatal region the hernia may be latent and symptoms the result of unrelated pathology.

Eighteen of the 28 patients were treated surgically after medical treatment had been tried over a reasonable period without relief. In 10 the approach was thoracic and in 8 abdominal. There were 2 deaths, one in each group, both the result of injury to the esophagus. With improved instruments and increased familiarity with the appearance of the esophagus and with the wide range of displacement which may exist, this risk has been eliminated.

OPERATION—CHOICE OF ROUTE

In determining the method of approach, many factors must be considered. Laparotomy is more direct, requires less time and produces less shock. Its application, however, has limitations. An extensively adherent viscus within the sac, coexistent with adhesions between the sac, lung, and pericardium may add much to the difficulties encountered at operation. The usual findings disclosed during thoracotomy were a herniated portion of the stomach in a sac, dilated peri-esophageal veins, and a network of adhesions between the hernial sac and diaphragm, pericardium and lung. This complication could not be dealt with easily from below.

As in traumatic cases and in congenital cases in children, adhesions and distended hollow viscera sometimes prevent reduction from below. In 1912 Fato[58] wrote that adhesions between stomach and pericardium made the thoracic route necessary. If the stomach were pulled down into the abdomen, traction on the pericardium would cause severe circulatory disturbance. Laparotomy was abandoned and the thoracic route employed by Frank,[59] Darvall-Barton,[60] Jopson,[61] Mann,[62] Hurst,[36] Fischer,[63] Lake,[39] and others. Olmstead[64] regretted that he had not used the thoracic route in a fatal case. Gibson[65] pointed

out the fact that when the stomach is markedly dilated, it cannot be pulled through a narrow aperture in the diaphragm from below. In one instance in which the patient died before operation could be done, Gibson wished that he had inserted a trocar directly through the anterior thoracic wall into the distended stomach. We suggest the use of the stomach tube in similar cases. In this instance the esophagus at the cardiac orifice and the duodenum just distal to the ampulla of Vater were occluded by pressure at the hiatus.

Quénu[5] cited Naumann's case reported in 1888 in which laparotomy was unsuccessful and thoracotomy was employed too late to save the patient. This is considered the first operative case of esophageal hiatus hernia recognized clinically. The same year Postempski[66] employed thoracotomy successfully in a traumatic case in a young boy.

The *x*-ray film is of assistance in determining the method of approach. When the cardiac end of the stomach, which is visible by *x*-ray above the diaphragm with the patient in the Trendelenburg position, does not descend when the position is changed to the upright posture, we conclude that adhesions have formed between the stomach and the sac and employ the thoracic route. We do not maintain that adhesions of the stomach within the sac cannot be severed from below. With the cardia drawn down into the abdomen, adhesions within the sac are put on tension and their division, though somewhat difficult, can be accomplished. However, adhesions of the sac to the esophagus, pericardium and pleura are shut off from the abdomen and their division becomes difficult, if not impossible. In dealing with the sac from below, a comparatively simple technique is to incise the peritoneum at the level of the diaphragm, establish a plane of cleavage which can be continued beneath the serosa lining the entire sac and remove the serous coat to the level of the pillars.

SURGICAL REPAIR OF THE HIATUS

Whichever method of approach is employed, operation is predicated upon the knowledge that acquired hiatus hernia in the adult presumably is caused by a loss of tone in the diaphragmatic musculature partially encircling the esophagus. It occurs more commonly on the left side. Digital examination of the hiatus during laparotomy or thoracotomy detects these bilateral muscle bundles which contract with inspiration and relax with expiration. During expiration the whole diaphragm is higher, even the central portion, while during inspiration the diaphragm descends and the hiatus closes as the dome flattens. When the muscles around the hiatus contract they descend and embrace the esophagus. Thus we observe one of the most interesting phenomena in the human body, the milking action at the lower end of the esophagus, a factor in the mechanism which makes swallowing independent of gravity. After mastication the food receives its impulse for deglutition from the musculature at the pharynx with which is coördinated the milking action at the hiatus; by this timing mechanism the food is carried downward by the peristaltic wave in the esophagus and retarded at the cardia before gentle pulsion carries it into the stomach in a left lateral direction.

A loss of tone and an abnormal spreading of the muscle structure forming the hiatus result in what might be termed a weak milking hand with retardation of the food column before it enters the stomach. As a rule, the muscle bundle on the right side has yielded little if any, whereas that on the left has stretched in minor or major extent, depending on the individual case. The widening of the hiatus is gradual, the slack usually extending laterally toward the left.

REPAIR BY THE THORACIC ROUTE

Although various methods have been described to open the chest wall, we believe the operation employed by Roberts of

London in most cases gives a satisfactory exposure. After making the customary incision through the soft parts, he divides

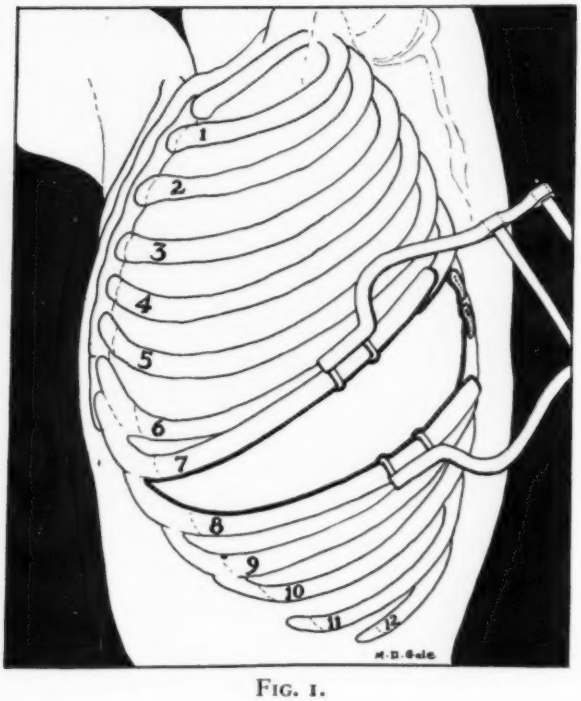


Fig. 1.

one or more ribs, usually the seventh and eighth, posterior to the tubercle. The intercostal pleura is then divided along the entire length of the incision. The use of a self retaining retractor with or without illumination gives adequate approach and light, to expose those parts of the diaphragm which ordinarily are considered inaccessible. (Fig. 1.)

In spite of the apparent logic of saving ribs, we have found that under certain circumstances such as the repair of very extensive apertures, it is unquestionably helpful to excise one or more ribs, particularly when the hernia occurs at the foramen

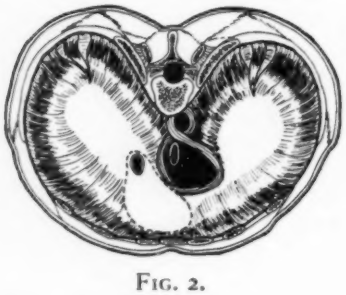


Fig. 2.

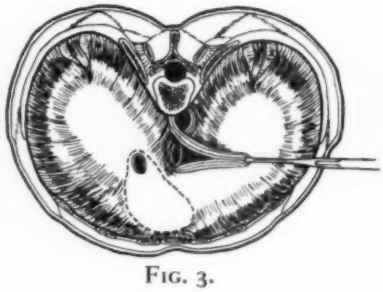


Fig. 3.

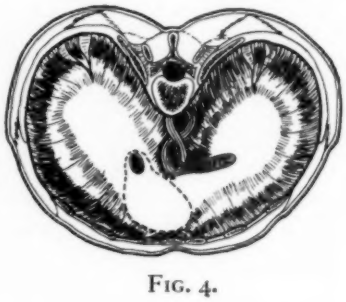


Fig. 4.

of Bochdalek. If there is no sac, adhesions are severed and the herniated organs reduced. If a sac is present, it is dissected free from adhesions and removed at the level of the diaphragm. The aperture at the hiatus of the diaphragm appears as in Figure 2. The outer extremity of this opening is seized with a pair of intestinal forceps and drawn laterally so that the borders are taut. (Fig. 3.) These edges are then brought into apposition with a running suture of silk reinforced with interrupted sutures of the same material. (Fig. 4.) After the hiatus has been repaired, the thoracic wall is closed by interrupted sutures of silkworm gut. In placing the sutures we find the Reverdin needle useful and timesaving.

REPAIR BY THE ABDOMINAL ROUTE

Through an abdominal incision the hernial orifice is seen from below after the stomach has been drawn down and the margins of the opening identified. (Fig. 5.) The relaxed crura in the form of a rounded muscle bundle are grasped with intestinal forceps and drawn into the field of operation. Bearing in mind the fact that the normal hiatus permits the introduction of one or two fingers, care must be exercised not to suture the musculature too closely about the esophagus. In placing sutures a metal depressor about one inch in width is used to guard against trauma to the esophagus. (Fig. 6.) If the muscle on the weak side is but slightly relaxed, the two sides may be evenly apposed by placing sutures vertically anterior to the esophagus, thus reducing the size of the hiatus to approximately normal. (Fig. 7.)

This method of repair, however, has one objectionable feature; the sutures, intended to close the hiatus, are actually uniting the two halves of the diaphragm. With the constant rhythmical contraction and relaxation of both sides, the strong traction exerted on the suture line is liable to result in a recurrence of the hernia. Consequently, the undesirably preoperative measure of phrenicotomy is practised routinely by some surgeons.

Fig. 5.

Fig. 6.

In a typical left sided hiatal hernia the relation of the two sides of the hiatus is in the form of a triangle with the right muscle bundle as its base. To suture this triangle vertically, sutures must be taken at greater intervals on the two left sides, resulting in a shirring on the left side. If both sides of this triangle, however, are brought together horizontally or laterally at a tangent, as in Figure 8, closure of the hiatus is limited to an operation on one leaf of the diaphragm; consequently there is less tension on the sutures and a decrease in the liability to a recurrence.

Closing the anterior angle vertically by two or three interrupted sutures, as in Figure 9 adds somewhat to the strength or holding capacity of the horizontal sutures as in Figure 10.

This operation employed to approximate the pillars of the diaphragm is somewhat similar to that used in uniting the levator ani muscles to strengthen the pelvic diaphragm. There is an interesting analogy between the anatomy of the central portion of the diaphragm and the muscle structures of the floor of the pelvis which exercise control and support of the rectum. (Fig. 11.) The crura of the diaphragm are tendinous in structure at their point of origin. The right crus, larger and longer than the left, arises from the anterior common ligament and intervertebral substance of the three or four upper lumbar vertebra; the left from the upper two. They pass forward and inward and gradually converge forming an arch, beneath which passes the aorta and thoracic duct. From this arch muscular fibers arise which diverge, the outer portion coursing upward and outward to the central tendon, the inner decussating in front of the aorta and then diverging, so as to encompass the esophagus. Divergence of these crura varies widely as Eppinger[67] pointed out in 1911. Stadtmüller's[48] experiments, however, proved that this variation had no causal significance in the origin of hiatus hernia.

In most cases the esophageal hiatus is formed by muscle fibers from the right crus, though it may be formed by fibers from both crura. The muscle fibers of the

right crus divide, the weaker slip crossing over to the left side; with restricted exercise and the consequent loss of muscle tone

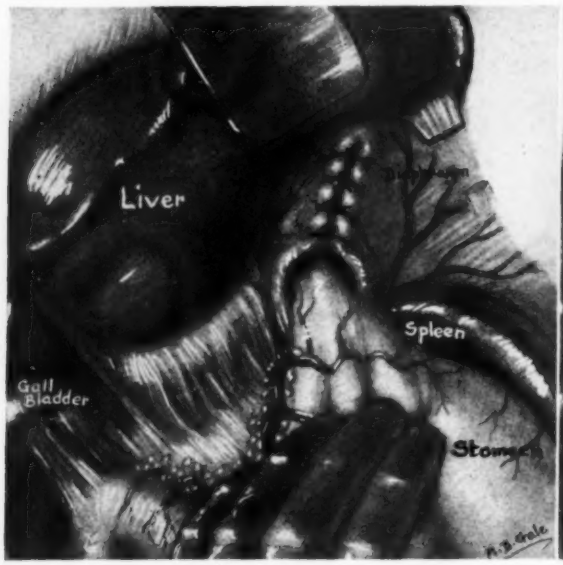


Fig. 7.

Fig. 8.

of advancing age, the musculature becomes slack and in certain individuals permits herniation of the stomach.

In a somewhat similar manner the levator ani muscles arise from the posterior

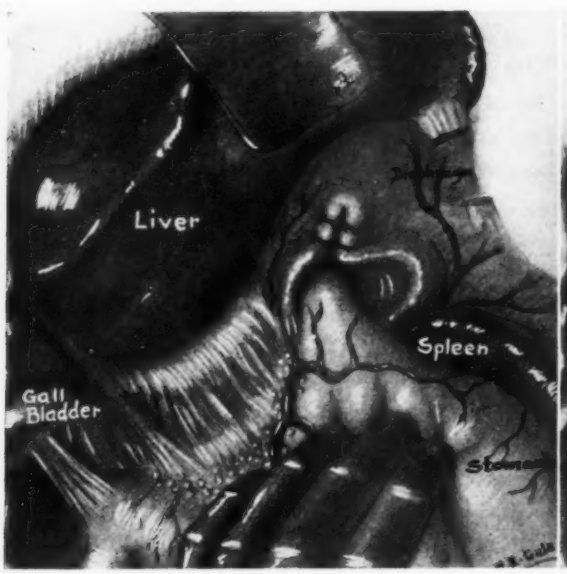


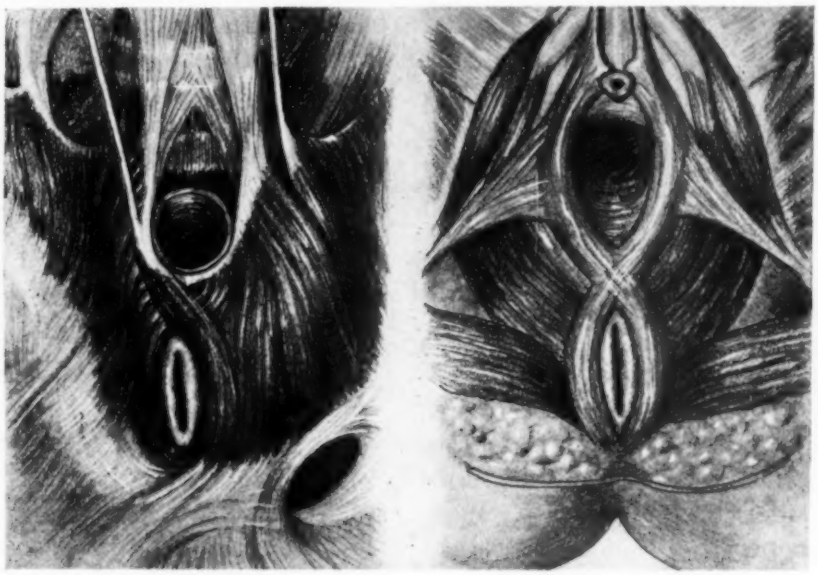
Fig. 9.

Fig. 10.

surface of the body of the pelvis, the spine of the ischium and the lower border of the pelvic fascia and *spread out fanlike to form the diaphragm of the pelvis.* In the female the anterior fibers pass along the sides of the vagina and meet corresponding fibers of the opposite levator ani muscle in the interval between rectum and vagina, where they are inserted into *the central tendon of the perineum.*

When the crura of the diaphragm relax and separate widely, the stomach rises above the level of the diaphragm through the hiatus forming a gastrocele, just as relaxation and separation of the levator ani muscles in late adult life form rectocele

and procidentia; the rectocele is a bulging of the rectum upward through the pelvic diaphragm, the procidentia a true hernia through the pelvic floor. Here the analogy stops. At the anus is a distinct sphincter muscle which exercises voluntary control and is not constant in action, whereas at the distal end of the esophagus there is no concentration of muscle fibers into a definite sphincter muscle and the action of the diaphragm is involuntary and unceasing. Although Hurst,[36] Anders[28] and others mention a definite sphincter muscle bundle at the lower end of the esophagus visible microscopically, after a careful postmortem examination of more than 15 specimens, we have been unable to find a concentration of muscle fibers at this site. It is possible that hypertrophy of the muscular coat of the terminal esophagus may occur from continued spasm and chronic irritation resulting in a condition similar to that associated with ulcer at the pylorus or fissure at the rectum. Whatever mechanism exists at the cardia is involuntary in action and intended merely to retard the column of food before it enters the stomach. By the Germans this lower portion of the esophagus is called the loitering canal, *Verdauungskanal.*



Diaphragmatic Area Pelvic Floor

Fig. 11.

THE HERNIAL SAC

The problem of dealing with the hernial sac is difficult by either method of approach but less so from above. Sauerbruch[51] and Lake[39] found the sac more accessible when the thoracic route was employed. When dealt with from above it can be separated readily from adhesions and removed in a manner similar to that employed in umbilical or inguinal hernia.

Although removal of the sac is always desirable, before attempting this one should consider the barriers to be overcome. When the sac is inaccessible Fischer[63] is content to clip the peritoneum at the rim of the hiatus to secure wound flaps. Hinz,[68] Sauerbruch[51] and Harrington[34] maintain that the sac should be completely cut from its attachment to the stomach and to the hernial opening before actual closure of the hiatus. If left, it may press against the pericardium and cause distressing symptoms. Hinz plicates the sac when feasible, a method which we have used in 4 cases.

When approached from below, the sac is drawn down to a level where it is accessible, the serosa lining the sac above is stripped off and the entire sac dissected free and removed.

PHRENICOTOMY

In operations for diaphragmatic hernia evulsion of the phrenic nerve has been practiced by some surgeons as a routine preliminary measure. There is no doubt that this adds to the strength of the repair operation, but it must be borne in mind that following phrenicotomy alterations occur in the structure and function of the entire diaphragm. For this reason the wisdom of this procedure is questioned. In 1934 Stanbury[69] recorded changes in the diaphragm after phrenicotomy found at autopsy in 11 cases. Evulsion of the nerve was according to the method of Félix. The duration of the paralysis varied from three weeks to six years. Atrophy of the diaphragm was evident as early as the third week and was complete by the fourth month. In some cases the diaphragmatic leaf had stretched and become a thin whitish membrane of parchment thinness. Under the microscope the atrophy was complete and uniform. In one case a few normal muscle fibers remained, denoting an accessory nerve supply but no actual regeneration was visible. In 10 cases there was marked distortion of the abdominal viscera.

Should the surgeon believe that paralysis of the phrenic nerve will facilitate surgical repair of the hernia, temporary paralysis by crushing is preferable to permanent paralysis. Whenever the abdominal approach is used, temporary paralysis may be obtained by crushing or by injecting the nerve. The phrenic nerve is accessible as it courses downward over the pericardium and temporary paralysis may be accomplished by the injection of a 70 per cent solution of alcohol or by crushing it with a pair of ordinary hemostatic forceps.

CONCLUSIONS

The present misunderstanding in regard to the incidence of diaphragmatic hernia is due to a confusion of hiatus hernia with congenital diaphragmatic hernia.

Hiatus hernia is relatively common. It has become one of the important causes of symptoms in the upper abdomen to be excluded by the roentgenologist. When it causes anemia from chronic bleeding and complaints simulating cholecystitis, chronic pancreatitis or peptic ulcer, surgical treatment is advocated.

Congenital diaphragmatic hernia is a rare anomaly, almost invariably troublesome and requires operative treatment.

With a view to differentiating these two types of hernia a tabular comparison of their various manifestations is presented. Differences based on a comparison of the developmental, anatomical and symptomatological evidence are recorded in outline form.

The operative treatment, avenues of approach, associated problems and methods of dealing with the hernial sac are discussed.

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REGIONAL ANESTHESIA

A FEW GENERAL CONSIDERATIONS*

HENRY S. RUTH, M.D. AND JOHN A. STILES, M.D.

PHILADELPHIA

INTRODUCTION

STATISTICS pertaining to the problems on anesthesia, both regional and general, are very difficult to obtain. These shall continue to be unavailable in sufficient numbers to be of value until more of the larger clinics and hospitals adopt comprehensive records which may be applied to a sorting machine, and which are in use at the Mayo Clinic and the State of Wisconsin General Hospital. Until such time remarks concerning the use and efficiency of any one given agent or method throughout the country, shall of necessity be confined to impressions gained from (1) the few reliable statistics available, (2) perusal of the current literature on the subject, and (3) observations made during visits to various medical centres. We believe it may be deduced from these sources that regional anesthesia in the past half decade has not greatly increased in numerical usage, but that, generally speaking, where it has been applied it has rendered increasingly satisfactory results. This premise being true, we believe that it would be both interesting and instructive, to consider a few of the factors which possibly have largely contributed to this increased general efficiency.

PRELIMINARY MEDICATION

It appears that the application of the correct preliminary medication may be the largest single contributor to increasing success, particularly for the patients. The rather ephemeral spectre of psychic shock has run the gamut from derision to being termed a definite complication by neuropsychiatrists. Nevertheless, it is more comforting to patient, surgeon and anesthetist, to be able to work on a quiet, relaxed and cooperative patient. We, as medical specialists in the field of anesthesia, believe that this subject is neither sufficiently understood nor applied with interest and efficiency. The drugs and dosage selected for preliminary sedation for regional anesthesia are too frequently dismissed as a matter of routine procedure. It appears to us that the vast knowledge gained from experience in preliminary narcosis for general anesthesia might well be applied also to the field of infiltration or conduction anesthesia.

The aspects of preliminary medication we shall consider are:—(1) the objective to be attained, (2) the drugs employed, (3) the range of permissable dosages and the time of their administration and (4) factors influencing the dosage.

The two main objectives are to contribute to the comfort of the patient and to minimize the dangers accompanying the anesthetic and the operation. It may be said at this point, that we believe that patients are more cooperative toward regional anesthesia if they are not informed that this method of anesthesia has been selected, but are made aware of it only after they are properly premedicated and the time has arrived for the institution of the block.

A combination of several drugs may be used advantageously to accomplish these purposes. Morphine produces some analgesia for the slight discomfort of the induction of the anesthetic, and when combined with scopolamine provides somatic and psychic sedation. One of the barbiturates should be given in the majority of instances; they not only add to the hypnosis,

* Read before the American Society of Regional Anesthesia.

but also are a valuable protection against the possibility of a procaine reaction.

The choice of the barbiturate to be given will determine the time of its administration, since their action time varies and some are more rapidly eliminated. The two derivatives of barbituric acid we ordinarily use, are barbitol sodium and pentabarbitol sodium. Barbitol sodium is eliminated very slowly, consequently it should be given before retiring. Thus it will insure physical and mental rest for the patient during the night and still be present in the body to protect against procaine the following day. But it would be useless to employ this agent one-half to one hour before operation. The dosage varies from 5 (0.324 gm.) to 10 grains (0.650 gm.) in adults. Pentabarbitol sodium is absorbed rapidly and may be given at least one-half hour before induction of anesthesia, but as it is eliminated in four to five hours it is not effective when given the previous night. The adult dose of this drug ranges from 0.5 gr. to 3 gr. (0.0324–0.195 gm.) by mouth.

Morphine, alone or combined with scopolamine, should be administered by hypodermic one to one and one-half hours before operation to exert its maximum effect. The usual dosage employed in children when systemic disease is not present is $\frac{1}{16}$ gr. (0.00405 gm.) from five to seven years of age; $\frac{1}{12}$ gr. (0.00540 gm.) from eight to ten years of age; $\frac{1}{8}$ gr. (0.00810 gm.) from eleven to fourteen years of age; over fourteen years of age the dosage is determined by the factors mentioned below, and will vary from $\frac{1}{6}$ to $\frac{3}{8}$ gr. (0.0108 gm. to 0.0243 gm.) or even more in occasional instances. Scopolamine when given with morphine is usually balanced in the ratio of $\frac{1}{100}$ gr. (0.00065 gm.) with $\frac{1}{4}$ gr. (0.0162 gm.) of morphine. Too great a degree of preliminary sedation should be avoided, because this state may either cause a patient to become restless from the lack of oxygen in extreme respiratory depression or the release of their inhibitions, or conversely, they may become so lethargic that they are unable to cooperate.

There are numerous factors which must be considered in deciding the dosage of all preliminary medication. (1) Is the age of the patient. Most of us are prone to exercise too great caution in children, when comparatively they will tolerate larger dosages than adults, but are apt to forget that the dosage must be diminished for individuals sixty-five years of age or older. (2) The factor of pain is important, since it increases the toleration to sedation, depending upon the intensity of the distress. (3) A patient exhibiting fever, especially of recent onset, will require more medication. On the other hand, one who has had a fever and has been bedridden over a long period of time, will permit considerably less than a normal individual. (4) Patients with specific toxemias, notably hyperthyroidism and neurosyphilis, are much more irritable than normal patients, and consequently more tolerant to larger doses. (5) Drug addicts, whenever possible, should first receive the usual dose of the drug to which they are accustomed, with the correct preliminary medication superimposed. If this is not practical, a much heavier dosage of the usual medication must be employed. (6) The factor of sthenicity is important and may be judged by the appearance of the patient and from a history of the type of work and recreation which he pursues. (7) The sex of the patient and the amount of apprehension manifested toward the procedure also exert their influence to complete the picture. After all these factors have been considered, the experience of the person prescribing guides him to select the proper drugs and their dosage.

AGENTS, PHYSIOLOGY AND PHARMACOLOGY

The same status exists regarding the agents employed for regional anesthesia as for the drugs available for therapy in numerous conditions where the ideal as yet has not been reached. Drug manufacturers have found a lucrative pursuit endeavoring to synthesize new agents as a substitute for procaine, and exploiting their supposed

advantages before sufficient experimental and clinical data have been accomplished. The result has been a flood of new agents on the market. It is true that many of these anesthetics have gained adherents, but, with the possible exception of metycaine, it appears that none of them may replace procaine in the entire scope of its applications. Some of these agents evidently possess increased efficiency in isolated instances, particularly for surface anesthesia, and some have their proponents for certain specific procedures. Nevertheless, it is conceded that procaine has not been approached for injection purposes, with regard to general reliability, consistency of action, low toxicity, and most certainly in the extent of both pharmocological and clinical study.

Reactions from procaine do not occur frequently and may be either mild or severe. In the literature the method of treatment for both types of reaction or the description of mild reactions, which possibly occur with greater frequency than is generally observed, are poorly described and insufficiently emphasized. Many times, procaine is injected with the utter abandon which may be employed with an inert substance. A knowledge of its toxic action and associated symptoms is too frequently not possessed or ignored by the administrator. The toxic symptoms which may develop are often interpreted as restlessness and incooperation on the part of the patient, or when more severe is attributed to other causes, as acute cardiac failure. It should be realized that procaine is a protoplasmic poison possessing an affinity for nerve tissue, therefore, large amounts present in the circulation will affect the central nervous system, particularly the brain and vital centres. Procaine injected into the tissues is gradually absorbed into the blood stream. Dunlop in his studies recently has shown that the liver, although not essential in the detoxification of procaine, performs this function more efficiently and rapidly than any other tissue, chiefly muscle. Thus he raises the question of the advisability of administering larger doses of procaine, as employed for local infiltration, to patients with impaired hepatic function. Procaine is excreted as such, or its end products, by the kidneys.

There are three main sources for toxic manifestations of procaine. The first of these is by overdose. Its toxicity is represented not by direct, but by geometric ration to its concentration. Various figures are given for the safe dosages with the indicated concentrations; from 300 to 750 c.c. of 0.5 per cent down to 20 to 60 c.c. of the 2 per cent solutions. Although the drug possesses a fairly wide margin of safety, these permissable dosages should be remembered and varied according to the physical condition of the patient. Too little also has been said of rapid injection and its effect on the rate of absorption. To decrease its absorption, and also to increase the length of anesthesia, epinephrine may be added and is effective up to a dilution of 1:50,000. Thus, 2 to 8 drops of a 1:1000 solution are added for every 100 c.c. Its addition should be guarded or eliminated, in the presence of thyrotoxicosis, any tendency toward vasoconstriction and for operations upon the fingers and toes.

The second method whereby toxic symptoms are produced is through idiosyncrasy. A case of apnea has been reported following the injection of 1 c.c. of 1 per cent procaine, and another where convulsions developed after the injection into the sacral canal of 3 c.c. of a 1 per cent solution. Where the idiosyncrasy is pronounced, warning may be given by the intradermal wheal becoming bright red, while a corresponding wheal with normal saline will not do so. Various grades of idiosyncrasy can be present, varying from the extreme, as the 2 cases cited, to faintness, dyspnea and excessive perspiration occurring several hours after the injection. Hewer reports a death following an injection of 16 c.c. of a 2 per cent solution. Lastly, toxic reactions are caused by an inadvertent intravenous injection. It has been estimated that the minimum

lethal intravenous dose is one-tenth that of the subcutaneous dose. When an intravenous injection is made, there is not a sufficient time interval for the detoxifying process into its end products to take place.

The toxic symptoms usually begin with restlessness and a state of confusion or apprehension, the pulse becomes slower and the blood pressure falls, the patient may complain of palpitations, the face will exhibit a pallor and be covered with cold perspiration; the finger tips, lips and ears may be slightly cyanotic; an increased respiratory rate, and nausea and vomiting may be noted. This same syndrome may be produced by a reaction from epinephrine, except that the pulse will become accelerated and the blood pressure increased, the former greater in proportion to the blood pressure rise. The pulse and the blood pressure, then, form the differentiating diagnostic factors. If the condition is progressive, or if an intravenous injection has been made, consciousness may be lost, the pupils dilate and convulsions may begin in a localized fashion in the face or in an extremity, and later become generalized. The respirations then become depressed, the blood pressure fall continues, and the pulse may remain slow or become rapid, due to anoxemia.

The treatment of these complications is comparatively simple and effective, the important initial step being the differentiation of the symptoms with regard to their origin. This is facilitated by keeping an accurate and constant observation of the blood pressure, a detail almost universally neglected with regional anesthesia, save in institutions having a well organized anesthesia department. If it is determined that the reaction is precipitated by epinephrine a few inhalations of oxygen suffice, for its action is evanescent and the condition will speedily wear off. If due to procaine, the patient should receive inhalations of oxygen, and a subcutaneous injection of epinephrine, minums 3 to 5, distributed over an area corresponding to the length of the hypodermic needle, followed by massage, or possibly better still, diluted in a small amount of saline, in order to hasten its absorption. If the situation is not under control and convulsions intervene, an intravenous barbiturate, such as sodium amytal or pentobarbital sodium, should be given very slowly until the convulsions are relieved. If depression is progressive to the extent that the minute volume respirations have fallen to an alarming degree, with a moribund patient, an endotracheal catheter should be inserted, and artificial respiration instituted with oxygen. If respiration suddenly ceases and no anesthetic machine is immediately at hand, mouth to mouth insufflation should immediately be done, until the arrival of the machine to continue artificial respiration. The interval consumed getting the machine after respiration has ceased, may be sufficient to cause death.

Cardiac depression is encountered rarely with procaine, and only after intravenous injection of large quantities. It has been demonstrated that if the respiratory depression is controlled by an efficient airway and by artificial respiration with carbon dioxide and oxygen, the blood pressure is elevated, color improves, and the resuscitation may be discontinued after there is evidence of the elimination of the drug, evidenced by the resumption of respiration. Although this latter reaction is very rare, knowledge of the correct form of treatment is a lifesaving factor, for it has been proved that ordinary circulatory and respiratory stimulants are of little value.

SCOPE AND GENERAL INDICATIONS

Regional anesthesia is perhaps the safest method of anesthesia at the present time, but it should be recalled that it is applicable only in a relatively narrow sphere. Difficulties are encountered when undue enthusiasm dictates its use where it may prove a deterring factor to the efficiency of the operation, or it is too difficult technically to induce, or where it is not indicated for psychological reasons. The

superiority of infiltration anesthesia for some minor operations, and in many instances on moribund patients, is indisputable. There are some situations where block anesthesia is of distinct advantage over inhalation types. Foremost of these are:—(1) complicating pathologies presented by the patient preclude the use of a general anesthetic or so reduce the permissible agents that the efficiency of the surgical manipulations are reduced, (2) its use will insure better surgical results, (3) certain anatomical regions facilitate its use, as anal margin operations and, (4) the economic aspects from the viewpoint of the patient.

A thorough knowledge of the possibilities of regional anesthesia are of particular value when pulmonary conditions will not permit satisfactory inhalation anesthesia. In this connection, we should not lose sight of the fact that fully as many, and in some instances, more postoperative pulmonary complications may follow regional anesthesia than carefully administered inhalation method. This is notably true of high spinal anesthesia for prolonged operations, probably because this procedure tends to materially reduce pulmonary ventilation during and for some time following the operation. An indisputable virtue of regional anesthesia rests with the ability of the patient to cooperate with and assist the surgeon in such operations as muscle transplants and multiple tendon sutures.

An important indication appears when the operative procedure interferes very little with the vital functions of the patient, but a prolonged inhalation anesthesia will needlessly affect metabolic activities. This is especially true when the operation demands complete muscular relaxation. Quite frequently a form of regional anesthesia will obviate prolongation of hospitalization, not required by a relatively minor operative procedure, particularly in many orthopedic manipulations and operations. On the other hand, when an operation is not apt to be confined in an area which is feasible to block, it may be an advantage to begin with some inhalation type of anesthetic. Thus the patient would not have to be subjected to two types of anesthesia with the attendant dangers of both.

Finally, the attempt should not be made to over-extend enthusiastically the use of regional anesthesia, so that the safety of the patient during the anesthesia and operation and his ultimate welfare are lost to view.

CONCLUSIONS

The efficiency and safety of regional anesthesia necessitates in addition to the usual technical experience of the anesthetist, (1) adequate preliminary medication, (2) a more comprehensive knowledge of the agents employed and, (3) a full recognition of its field of application.

RENAL ARTERIOGRAPHY*

PRELIMINARY REPORT OF EXPERIMENTAL STUDY

R. B. HENLINE, M.D., F.A.C.S. AND S. W. MOORE, M.D.

Associate Attending Urologist, New York Hospital (James Buchanan Brady Foundation); Attending Urologist, Manhattan General and New York Foundling Hospitals

Assistant Surgeon, Cornell University Medical School; Assistant Resident Surgeon, New York Hospital

NEW YORK CITY

THIS paper recounts our experiences with various contrast media for radiography injected into the aorta of dogs, in an attempt at visualization of the renal circulation.

The abdominal aorta of living humans has been directly injected successfully by several European observers and radiographs obtained of the arterial circulation. The renal artery and its branches have also been well visualized in some instances;[7,18] these have aided in diagnosis and any method of investigation which may assist in urologic diagnosis is, we feel, deserving of experimental study.

Radiographic study of the circulation is not new. The injection of contrast media into vessels for the purpose of obtaining radiographs of various portions of the circulation, dates back to Destot and Berard,[5] in 1896. It was not until 1923, however, that injection of the arteries in living humans with solutions rendering them opaque to the *x*-ray was first reported by Sicard and Forestier.[5] Barney Brooks,[3] in 1924, was the first to use 100 per cent sodium iodid to obtain arteriographs in the leg. In 1929 dos Santos, Lamas and Caldas first described a method of puncturing and injecting the abdominal aorta with opaque solutions to obtain an arteriograph of the visceral arterial circulation. This procedure has since been followed by several other Europeans.[4,12,19,21]

Dos Santos[5] stated that he has punctured and injected the aorta without a single accident in more than 300 living individuals. Balestra, however, states that dos Santos had 7 deaths following aortic arteriography, 5 of which occurred on the twentieth, sixteenth, fourteenth, sixth and fifth days respectively. These were unexplained except for some atheromatous changes in 3 cases. The sixth patient died from a hematoma and the seventh died following hysterectomy; in the latter case there was ecchymosis of the aorta although the needle puncture could not be seen.

Dos Santos'[5] technic is as follows: He inserts a needle, 12 to 14 cm. in length and 1.2 mm. in diameter, with a stylet, at the level of the twelfth dorsal and second lumbar vertebra. The stylet is withdrawn and from 15 to 20 c.c. of solution injected with a pressure of 2.5 Kg. and an *x*-ray taken immediately. A solution of 100 per cent sodium iodid or a mixture of ⅔ abrodil (85 per cent) with ⅓ sodium iodid (150 per cent) gives the best results. A general or spinal anesthesia is required because of the severe pain from the injection of these solutions. He states that from 40 to 45 grams of sodium iodid have been given without toxic symptoms. The only reactions he has encountered are dryness of the throat and mouth, passing sensations of great distress, and, rarely, subsequent acne, oliguria, albuminuria and diarrhea.[6]

The interpretations of the results shown in dos Santos' book offer excellent evidence of the diagnostic value of arteriographs. The aortic reflux, showing the contrast

* From the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital and the Department of Surgery, Cornell University Medical College.

media rising above the level of the puncture, is the result of the constant pressure of the aortic injection during cardiac diastole. Tumors, cysts and aneurisms, as well as certain inflammatory lesions, may be visualized.

According to dos Santos,[8] arteriographic study of the renal circulation offers valuable information regarding the function of the kidney. A large renal artery would suggest an hypertrophy; a small one atrophy from some lesion interfering with the renal function, such as infection, tuberculosis or hydronephrosis, while absence of a pedicle signifies functional absence of the organ. The shadow of the kidney and its contour is much sharper than in simple radiographs. A darker radiograph of a kidney signifies the presence of more contrast media and hence a more normal kidney. Aberrant renal circulation is clearly outlined, so that one may diagnose not only a renal neoplasm, with its abundant circulation, but also a small vessel which may be the cause of a ureteropelvic obstruction. The renal area supplied by this artery may be outlined and renal anomalies clearly demonstrated with arteriography.

He concludes that since so much additional information is obtainable from arteriograms and since no accidents or complications have resulted from over 300 aortic punctures, this method of investigation should be frequently employed.

EXPERIMENTAL STUDY

Despite this enthusiastic report, we felt that more information should be obtained from animal experimentation before we could feel justified in employing the procedure in humans. Twenty-one dogs were therefore injected with solutions of sodium iodid of either 50 or 100 per cent, skiodan, uroselectan B, thorotrast, iopax or sterile normal saline.

TECHNIC OF INJECTION

The dogs were anesthetized with intraperitoneal injections of sodium amytal or by ether inhalation. The back was shaved and prepared at the left costovertebral angle. A needle with a stylet was

Fig. 1. Dog 11. Aorta injected rapidly with 10 c.c. of 100 per cent sodium iodid. Note the reflux up the aorta. Right kidney is well visualized.

inserted two fingers breadth to the left of the spinous processes and just under the thirteenth rib medially and cephalad at an angle of about 15° until the body of the vertebra was met. By withdrawing the needle slightly and reinserting it at a smaller angle, the needle became tangent to the body of the vertebra and was inserted to the aorta. A definite resistance was encountered just before the aorta was punctured. As the aorta was punctured, the distal end of the needle pulsated with

each systolic contraction. On withdrawing the stylet, a spurt of arterial blood assured one that the aorta had been entered. A rubber tube connection permitted the dog to be placed on his back and the aorta injected with a luer syringe. *X*-rays were taken at varying intervals following injection of the drugs. In some instances an attempt was made to compress the iliac vessels or the lower portion of the aorta to obtain greater concentration of the injected fluid in the visceral circulation.

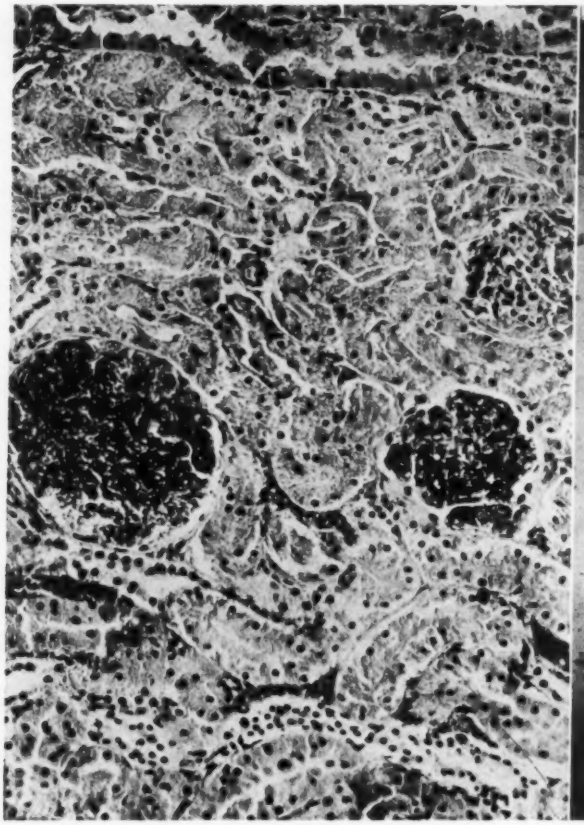

FIG. 2. Dog II. Congested glomeruli and vessels with some hemorrhage.

FIG. 3. Dog III. Aortic media is split and filled with blood clot. Note area where the needle punctured the aorta.

The following are brief résumés of our experiments:

Dog I. Intraperitoneal sodium amytal anesthesia. A Lindeman needle was tied in the femoral artery and a No. 4 F. ureteral catheter passed through the needle up the aorta above the kidney region. Ten c.c. of 100 per cent sodium iodid was injected and *x*-rays taken. *X*-ray: No arteriograph because of slow injection. The dog died in twenty hours. Autopsy showed fibrin and fluid in the left pleural cavity and inflammation of the peritoneum.

Dog II. Sodium amytal anesthesia. The abdomen was opened and the entire intestine, stomach and spleen removed. The aorta was punctured with a 20 gauge needle, 10 c.c. of 100 per cent sodium iodid injected rapidly and *x*-ray taken at once. (Fig. 1.) During the injection the surface of the kidneys assumed a mottled bluish color which increased as the sodium iodid was injected. The needle was removed and blood spurted from the aortic puncture for several minutes, and was stopped with difficulty. The kidneys became normal in color before the dog was sacrificed. Microscopic section of the kidney (Fig. 11) showed hemorrhage into some glomeruli and granular appearance of parts of the tubular epithelium.

Dog III. Sodium amytal anesthesia. An 18 gauge needle was inserted at the costovertebral angle into the aorta after several attempts, 10 cc. of 100 per cent sodium iodid injected, and *x*-ray taken at the end of the injection. After twenty minutes 10 c.c. more was injected and another *x*-ray taken. The needle was removed, and a hematoma rapidly developed in the

back in the region of the puncture. *X*-rays showed the vessels satisfactorily outlined. The dog died in twelve hours. Autopsy revealed

Fig. 4. Dog IV. Ten c.c. of 100 per cent sodium iodid injected into the aorta. The renal arteries are well outlined. Note compression of lower abdominal aorta.

bleeding from the mouth and nose, gas in the abdomen with 200 c.c. of bloody fluid, also blood in both pleural cavities. A dissecting retroperitoneal hematoma was present and a large hematoma in the muscle layer of the back. Figure 3 shows the aortic media split and filled with blood clot as well as some blood in the adventitia.

Dog IV. Sodium amytal anesthesia. An 18 gauge needle was inserted into the aorta and 10 c.c. of 100 per cent sodium iodid injected rapidly. Clonic spasms of the lower extremities were present during injection. *X*-ray taken two seconds after injection was completed. (Fig. 4.) The dog died in five hours. Autopsy revealed

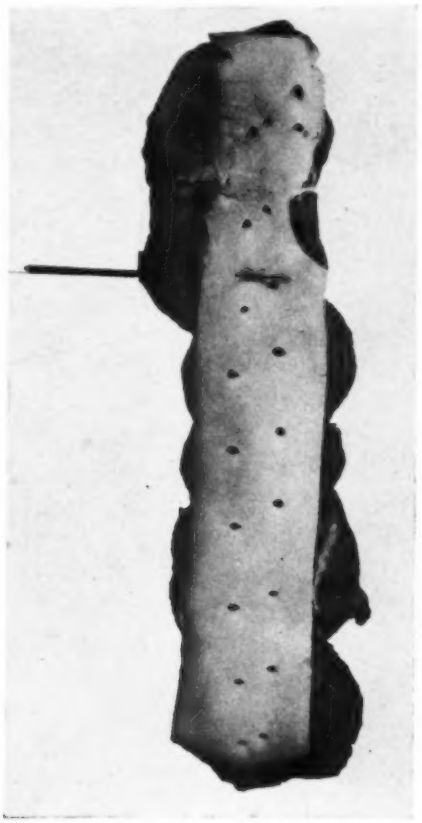

Fig. 5. Dog IV. Dog died five hours after aortic puncture. Shows large hematoma surrounding the aorta which caused death.

bloody fluid in the abdominal and both pleural cavities. There was a dissecting hematoma reaching halfway up the thoracic aorta. (Fig. 5.) The bladder was filled with bloody urine.

Dog V. Sodium amytal anesthesia. A 22 gauge needle was inserted and thought to be in the aorta. Twelve c.c. of skiodan was injected and *x*-ray taken, showing injection *outside* the aorta. One week later 10 c.c. of uroselectan B was injected. *X*-ray showed no arterial visualization. The dog died six weeks later.

Dog VI. Sodium amytal anesthesia. Ten c.c. of skiodan was injected through a 20 gauge needle. *X*-ray showed no arteriograph. The dog died sixty-three days later.

Dog VII. Dial anesthesia. A 20 gauge needle was inserted and 10 c.c. of 100 per cent sodium iodid injected. *X*-ray showed the needle was not in the aorta. The needle was reinserted and 10 c.c. more injected. The

x-ray was fairly satisfactory. The dog died five hours later. Autopsy showed some hemorrhage around the site of the aortic puncture,

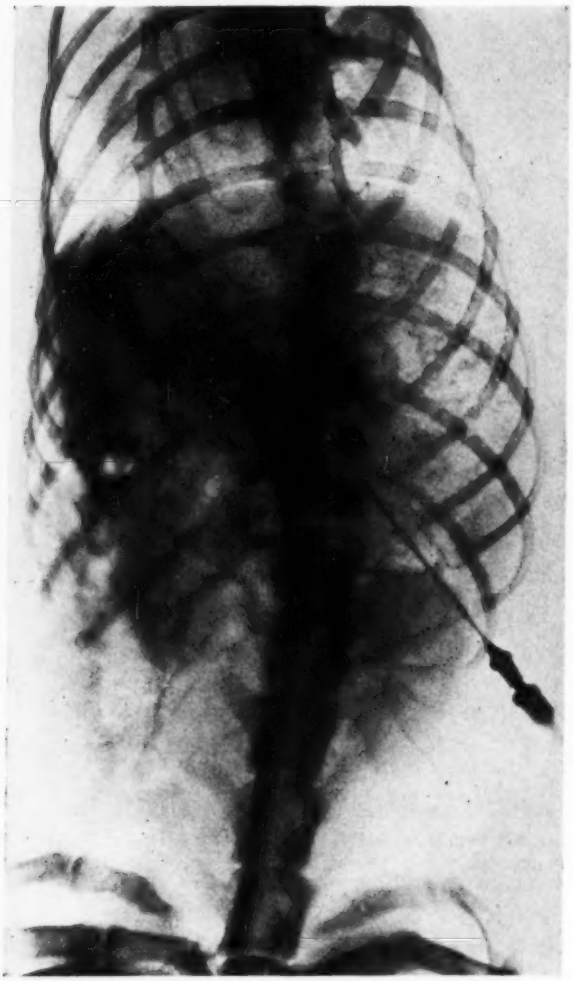

FIG. 6. Dog IX. Aorta injected with 2 c.c. of 100 per cent sodium iodid. Left renal artery distinct. Died in four days.

renal glomerular hemorrhage and marked congestion of the liver.

Dog VIII. Sodium amytal anesthesia. Ten c.c. of 50 per cent sodium iodid was injected through a 20 gauge needle into the aorta. Recovery seemed normal. *X*-rays were fairly satisfactory. The dog died several weeks later.

Dog IX. Sodium amytal anesthesia. Two c.c. of 100 per cent sodium iodid was injected through an 18 gauge needle into the aorta. The *x*-ray was satisfactory. (Fig. 6.) The dog died in four days.

Dog X. Sodium amytal anesthesia. Ten c.c. thorotrast injected through a 20 gauge needle into the aorta. The *x*-ray was satisfactory. The same injection was repeated and *x*-ray showed a faint shadow of the large vessels. The dog died several weeks later.

Dog XI. Ether anesthesia. Ten c.c. of thorotrast was injected through a 20 gauge needle into the aorta and *x*-ray taken. No arteriograph. The dog died thirty-six days later. A healed aorta was shown at autopsy. (Fig. 7.)

Dog XII. Ether anesthesia. Ten c.c. of thorotrast injected through a 18 gauge needle. *X*-ray showed faint arterial outlines. Ten c.c. more was injected and one hour later another *x*-ray taken. This showed an accumulation of thorotrast in the liver. The dog died in fourteen hours. Autopsy showed a small amount of blood in the pleural cavity, hemorrhage around and in back of the aorta from the mediastinum, retroperitoneally, lifting up the kidney and filling the pelvis. The aortic puncture was seen, with the intima reddened and infiltrated with blood.

Dog XIII. Ether anesthesia. Five c.c. of 100 per cent sodium iodid was injected through a 20 gauge needle into the aorta. The *x*-rays were fair. The dog had bloody diarrhea and died in nine days. Autopsy showed very little bleeding around the aorta, the aortic puncture seemed closed, the kidneys appeared slightly bluish in color. Microscopic sections of the kidney showed hemorrhage both in the glomeruli and the intertubular spaces.

Dog XIV. Ether anesthesia. Ten c.c. concentrated uroselectan B was injected through a 20 gauge needle. The *x*-rays were negative. The dog recovered and was used one month later as dog XVIII.

Dog XV. Ether anesthesia. Ten c.c. of 42 per cent thorotrast was injected through a 20 gauge needle and *x*-ray taken. It was not satisfactory. The dog died forty-seven days later.

Dog XVI. Ether anesthesia. Twelve c.c. of argo-iodin was injected through a 20 gauge needle into the aorta, followed by severe reaction and death. The *x*-rays were unsatisfactory. Silver chloride was found in the arteries. Figure 8 shows the punctured aorta.

Dog XVII. Ether anesthesia. Forty c.c. of neo-iopax was injected through an 18 gauge needle into the aorta. The *x*-rays were negative. The dog died one month later.

Dog XVIII. Ether anesthesia. Forty-five c.c. of thorotrast was injected through an 18 gauge needle into the aorta. The *x*-rays

were unsatisfactory. The dog died twenty-five days later.

Dogs XIX, XX, XXI. Ether anesthesia.

Fig. 7. Dog xi. Aorta at point of puncture thirty-six days previously. Note healing by fibrosis.

Fig. 8. Dog xvi. Recent puncture of aorta.

Each dog was injected with 10 c.c. of normal saline, using needles of 18, 20, and 22 gauge. Recovery seemed complete and the dogs were apparently normal in every respect. However, the dogs died from four to six weeks later.

COMMENTS

It is surprising with what relative ease the small aorta of a dog can be located and punctured with a needle. Prevention of serious hemorrhage apparently depends partly upon the size and construction of the needle. In most of these dogs a 20 gauge needle with a short bevel was employed, although both larger and smaller needles were used in some cases. The needle must be sufficiently large to allow for the rapid injection of fluid so that the concentration of the contrast media in the large vessels will be adequate to cast a shadow on the *x*-ray film. A larger needle with a long bevel predisposes both to unnecessary injury of the aorta and to postoperative hemorrhage; a smaller needle prevents the proper rate of injection into the aorta. The exposed aorta in dog 11 bled rather profusely following the puncture of the aorta with a 20 gauge needle.

The only solution which gave satisfactory arteriographs was 50 or 100 per cent sodium iodid. Since it required a very concentrated contrast media to cast a shadow of the arteries, because of the circulatory pressure, the injections of skiodan, uroselectan B, and iopax failed to outline the vessels. The arteries were faintly outlined with thorotrast. This thorotrast[22] (thorium dioxid) is absorbed readily by the reticuloendothelial system, particularly of the liver and spleen and is retained in these organs for indefinite periods of time. The council of pharmacy and chemistry of the American Medical

Association has voted against the use of thorotrast for intravenous administration because of its imperfect elimination, its

Fig. 9. (From dos Santos, Lamas and Caldas.) Human aortic arteriograph showing renal arteries and calculus in left kidney.

fairly high alpha-ray activty, the possibility of further increase in its radioactivity by partial conversion to mesothorium and radiothorium, and the possibility of sensitization of tissues to the roentgen rays.[14] It is unfortunate that the safety of this drug must be questioned, since its particular affinity for the liver and spleen have made possible the visualization of these organs never before properly seen with the *x*-ray.[6,9,11,16,23,24]

The spasms noted following the injection of sodium iodid, even when the dog was completely anesthetized, speak for the sudden shock to the tissues. Unquestionably, a sudden hardship is placed on all tissues with which concentrated sodium iodid comes in contact.[11] This is evidenced by the bluish appearance of the kidney following the arterial injection of sodium iodid (dog 11), impressing one with the fact that the renal circulation is temporarily impaired. Normal tissues may overcome this sudden insult but one would be reluctant to subject a damaged organ to this temporary injury.

Legueu, Fey and Truchot[13] have utilized dos Santos' method of aortic artiography in 20 human cases. Four of these manifested rather severe reactions: one from iodism, one nephritis, one hematuric nephritis, and one an alarming case of hyperazotemia with edema, which, however, resulted in recovery. Although they believe this new means of investigation to be of the utmost importance in difficult cases, it still is not entirely without danger.

Paolucci[17] found that 100 per cent sodium iodid injected into the arteries of dogs caused destruction of the intima and necrosis of the media and adventitia in some instances. Chemical changes in muscle fibers were also noted, together with blood clots in the lumen of the artery. He states, however, that 25 per cent sodium iodid and 40 per cent uroselectan caused no damage.

DISCUSSION OF CASES

Five of our dogs which died showed evidence of traumatic hemorrhage due to the aortic puncture itself. Possibly the size of the needle or the multiple punctures of the aorta, may have caused this unusual hemorrhage. Three of the deaths were apparently due to the toxicity of the drug used, as proved by the gross and microscopic appearance of both the kidneys and the liver. The glomerular hemorrhage which extended into some areas of the parenchyma, and the marked congestion of the liver gave evidence of the toxicity of the drug. Only one dog recovered completely and was utilized in another experiment. Twelve dogs died several weeks after the arotic puncture in which no gross or microscopic evidence of damage to the aorta, kidneys, liver or spleen was

demonstrable. Their recovery, following puncture of the aorta and injection of small amounts of various contrast media, was apparently complete, showing no ill effect from this procedure.

In 4 of these 12 dogs the aorta was punctured with an 18 gauge needle, in 6 with a 20 gauge needle, and in 2 with a 22 gauge needle.

Two of these dogs were injected with sodium iodid, 2 with skiodan, 4 with thorotrast, 1 with neo-iopax, and 3 with normal saline. It should be noted that our dosage of sodium iodid was greater per kilogram than dos Santos'; this was probably a factor in the causing of death.

Several autopsies revealed hemorrhage not only from the aortic puncture but in the pleural sac (dogs II, III, IV, and XII), abdominal cavity (dogs I, III, and IV), and occasionally from the mouth and nose and bloody urine in the bladder. Glomerular hemorrhage with congestion of the renal vessels was a common finding in dogs dying shortly after injection (Fig. 2). Although a ragged puncture of the aorta is present for a short time after insertion of the needle (Fig. 8), it apparently heals by fibrosis within thirty-six days (Fig. 7). The aortas of two dogs showed a separation of the media, which was filled with a blood clot (Fig. 3), and some evidence of hemorrhage in the adventitia.

ADVANTAGES AND DANGERS

Although much additional experimental evidence is necessary, it is our impression, from this preliminary study, that the danger of aortic arteriography in dogs is too great to compensate for the information obtained from the *x*-ray film. Other more simple methods of diagnosis are sufficient in almost all conditions in which arteriography is helpful. Because of the danger of hemorrhage and the toxicity of the solutions required for arteriographs, we feel that further experimentation is necessary before the use of this procedure in humans can be advocated.

CONCLUSIONS

1. The aortas of 19 dogs were punctured by inserting a needle at the left costovertebral angle past the vertebra into the aorta. The needles varied in size from 22 to 18 gauge. The aorta of one dog was punctured under direct vision after removal of the abdominal viscera, and an aortic injection was made through an ureteral catheter passed up the femoral artery.

2. Solutions of 50 or 100 per cent sodium iodid, skiodan, uroselectan B, iopax, thorotrast or sterile normal saline were used in different dogs. Concentrated sodium iodid alone gave radiographs which were sufficiently clear for diagnostic purposes.

3. Five dogs died shortly after the aortic injections from traumatic hemorrhage. Three dogs died apparently from the toxicity of the drug. Twelve dogs apparently completely recovered from the operation and examination of the aorta, kidneys, liver and spleen failed to show any damage.

4. Gross and microscopic evidence of damage to the aorta, kidneys and liver was shown in some instances, such as separation of the layers of the aorta, hemorrhage into the renal glomeruli and parenchyma and congestion of the liver.

5. This preliminary report shows the ease with which an aorta may be punctured and injected with solutions. Extreme care must be exercised in the puncturing of the aorta as well as in the selection of the solution used for arteriography.

These experiments were conducted in the Department of Experimental Surgery, and the authors are grateful to Professors Heuer and Sweet for the many courtesies extended.

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[*For Remainder of References see p.* 290.]

SIMPLIFIED LOCAL VAGINAL HYSTERECTOMY

INDICATIONS AND CONTRAINDICATIONS

A. SAMPOLINSKI, M.D., F.A.C.S.

Associate Clinical Professor of Surgery, Loyola University; Senior Surgeon, St. Mary of Nazareth Hospital

CHICAGO, ILL.

OVER three hundred years ago Cruce did the first vaginal hysterectomy apparently for a carcinoma of the uterus. The operation was performed without following any systematic procedure and in the majority of cases the uterus was prolapsed as well as carcinomatous.

Sauter began systematic operation, when he successfully extirpated the uterus in situ by the vaginal route. Recamier also accomplished the same purpose after ligating the lower broad ligaments. The work of Sauter and Recamier was followed by Billroth, Czerny, Schroder, Rean, Segond, Richlos and Doyen and was performed regularly until 1830.

In 1830 Freund's success with abdominal hysterectomy caused a change in the attitude and only forty years ago Czerny restored the recognition of the importance of vaginal hysterectomy, nearly all his operations being performed for either prolapse or carcinoma.

In America the first vaginal hysterectomy apparently was done in 1829 by J. Collins Warren. In 1882 Fenger gave a detailed description of vaginal hysterectomy which was done only in cases of prolapse, inversion and carcinoma case reports by various operators then were published.

Vaginal hysterectomy is performed more frequently in Europe than in the United States. Dr. Van Grover, of the Krakow University, Poland, stated that the majority of hysterectomies in Europe are performed vaginally for two reasons:

1. It is more economical because the operation is performed under spinal anesthesia, which is very cheap.

2. Recovery after the operation is much faster, not requiring as long a hospitalization as is necessary in abdominal hysterectomy, and therefore is more economical for the indigent patients.

Recently in the United States, vaginal hysterectomy is again coming more into favor because its mortality rate is one-third that of abdominal hysterectomy, due to less trauma to the viscera; and, postoperative shock is almost nil, while death following abdominal hysterectomy, as a rule, is from shock or paralytic ileus or both, caused by excessive manipulation of the bowels, which stimulates the sensitive sympathetic nervous system.

The least complication is encountered in cases of procidentia uteri, where the tissues are not friable. The danger of postoperative hemorrhage is not as great as in other pathological cases, therefore the uterus can be removed easily, but the success of the operation for prolapse depends upon the wide mobilization of the bladder and rectum. Dr. Charles H. Mayo recommends suturing the stumps of the broad ligaments.

Dr. Channing Barrett simplifies this technique, especially when the stumps of the broad ligaments are short and it is not feasible to unite them. He supports the angle of the vagina by suturing the anterior and posterior vaginal wall on each side to the corresponding stumps, so that the procedure gives good support to the bladder and anterior portion of the rectum.

INDICATIONS FOR VAGINAL HYSTERECTOMY

1. Complete prolapse of the uterus, especially after the menopause

2. In cases of cancer of the fundus, where the growth is still localized

3. In epithelioma of the cervix not involving the vaginal wall

4. Small fibroid, bleeding uterus

5. Infected uterus
6. Carcinoma in old and obese patients, where the abdominal operation is contraindicated, and in those in whom the corpus uteri is not too large, without evidence of an invasion to the surrounding tissues nor of an infection of the inguinal lymph glands.

CONTRAINDICATIONS

1. Extensive adhesions of the uterus
2. Advanced disease of the adnexa
3. Too large a uterus

Dr. Channing Barrett performed more than 2000 vaginal hysterectomies in forty years of practice, prefers the vaginal route in all cases where such an operation can reasonably be accomplished.

In cases of cancer of the cervix, where the disease is far advanced and where a radical extirpation by the abdominal or vaginal route is impossible, the best treatment aside from the radium treatment, is thorough cauterization as recommended by Drs. Burnes and Percy, of California.

Dr. A. J. Ochsner simplified cauterization of the uterine cavity by using an ordinary red-hot plumber's iron, heated over a gas stove. An iodoform gauze, covered with glycerine, is then inserted into the uterus and a retention catheter is introduced into the bladder. This type of operation not only protects the vaginal wall from invasion, but after the eschar which forms during the process of healing, separates, the connective tissue contracts the organ and is likely to stop the progress of the disease. Many of these patients improve to such an extent that the surgeon is prone to doubt his diagnosis because some of these inoperable and hopeless cases may be operated later, or if they refuse an operation, they continue to live for a period of several years.

If there is the slightest suspicion of malignancy, especially in women at the menopause or thereafter, hysterectomy should be performed at once. Removal of a portion of the tissues for microscopic examination or diagnostic curettage should be condemned, unless frozen section examination is made immediately and the patient is prepared for hysterectomy or radium treatment, should malignant changes be present.

Due to the speedy recovery and low mortality after vaginal hysterectomy, many articles on the improved technique of this procedure have been published recently.

The technique I am describing is Dr. Channing Barrett's. It is so simple that any surgeon can perform a vaginal hysterectomy with a good result and a low mortality rate.

PREOPERATIVE PROCEDURES

First, by manual examination, determine the size, consistency and mobility of the uterus and whether or not it has undergone malignant changes.

On the day before the operation the patient is given a potassium permanganate (1:500) or lysol douche; then the routine preoperative orders.

The blood pressure and coagulability should be ascertained, in addition to the routine blood and urine examination.

The night before the operation the patient is given phenobarbital grains 3 which permits quiet rest through the night.

At 6:00 A.M. the patient receives phenobarbital grains 3 and half an hour before the operation a hypodermic injection of morphine sulphate grains $\frac{1}{4}$ and atropin, grain $\frac{1}{100}$ so when brought to the operating room she is in an analgesic stage.

TECHNIQUE

The patient is placed in the extreme lithotomy position the hips projecting about 3 inches over the edge of the table.

Immediately after the patient has been anesthetized, the vagina should be thoroughly washed with soap and water, and then irrigated with a 1:1000 solution of bichloride of mercury and 50 per cent alcohol.

A heavy weight retractor is used to retract the posterior vaginal wall.

Two assistants, one with his right hand over the patient's left leg and another with his left hand over the patient's right leg, hold the ribbon retractor, to separate the lateral vaginal walls and expose the cervical portion of the uterus.

The cervix is caught with the heavy volsellum forceps and drawn forward. The position and consistency of the uterus is determine with a uterine sound. The cervix and the vagina is swabbed with tincture of iodine and the excess washed off with alcohol on a sponge.

With 1 per cent novocaine infiltrate the cervix all around ¼ inch below the reflection of bladder over the cervical wall, which should be determined by a sound. Make a circular incision around the cervix, about ¾ to 1 inch from its edge. Strip the anterior portion of the vaginal wall with gauze, manipulating it so that the bladder wall will be pushed upward. Using gauze the posterior vaginal wall is stripped as far as possible, to prevent injuring the rectum.

If the patient is under phenobarbital and morphine analgesia, the stripping of the anterior and posterior vaginal walls could be done very easily and painlessly.

If the patient complains of pain a novocaine infiltration (under the elevated portion of vaginal wall) can be done very easily.

The peritoneal fold is injected with 1 per cent novocaine and an incision is made into the posterior peritoneal fold of the cul de sac of Douglas spreading the peritoneum with dull scissors and the index fingers.

The anterior peritoneal fold is then recognized and injected with 1 per cent novocaine, incised, and the peritoneum spread with dull scissors and the index fingers, care being taken that the bladder is not injured. The best guide for the prevention of injury is to introduce a sound into the bladder and cut the peritoneal fold posterior to it. The index finger of the right hand is inserted into the peritoneal sac, the bladder wall and the intestines pushed away from the operative field and the adnexa examined.

The tenaculum forceps are pulled forward and to the patient's left, 1 per cent novocaine is injected and heavy hemostatic forceps applied over the right uterine artery close to uterus to avoid the right ureter, and tightened securely so that it will not slip off; then the uterine artery is severed, cutting away from the forceps next to the uterus so that the forceps will not slip off the tissue.

The same thing is done reversely, on the left side of the uterus. One per cent novocaine is injected and then the cervix is amputated as high as possible. Cutting the cervix high is a very important procedure in vaginal hysterectomy, because the infected cervix is eliminated from the operating field and helps to rotate the uterus.

After the cervix is severed, if the uterine canal is enlarged and there is evidence of infection, a strip of iodoform gauze saturated with iodine can be pushed into the remaining portion of the uterine canal and the canal closed with a stitch, burying the iodoform gauze in the uterus and thus protecting the abdominal contents from possible infection and peritonitis.

The bladder wall is pushed away from the operating field and the uterine body grasped with heavy tenaculum forceps, with another tenaculum forceps advancing slowly and pulling the body of the uterus forward until the entire uterus reverses; that is, the cervical portion of the uterus will point upwards toward the abdominal cavity and the body of the uterus will fall forward into the vagina.

If the adnexa are pathologic and are to be removed, a sponge is placed in the culdesac of Douglas to prevent protrusion of the intestines, the body of the uterus pulled forward and to the patient's left and strong forceps applied from above downward including the round and the upper portion of the broad ligament and right ovarian vessels. The second forceps may be applied over the lower end of the broad ligament. After the right adnexa are cut free, the left can be secured more easily in the same manner.

The round ligament and the upper portion of the broad ligament and ovarian artery on right side are ligated with chromic catgut; then the same ligation is done on the left side. The right uterine artery is ligated with chromic catgut, transfixing it; then the left uterine artery is ligated. All the ligatures on the ovarian and uterine arteries should be done quite high from the forceps, to prevent the ligature from slipping.

The wound on the right side is sutured with the chromic catgut, stitching through the anterior portion of the vaginal wall, the peritoneum, the round and broad ligaments, and then through the posterior peritoneum and the posterior portion of the vaginal wall, so that the stump of the broad and round ligaments will lie at the angle of the vagina. The same procedure is followed on the left side. This gives ligamentary suspension to the upper part of the vagina, preventing it from prolapsing.

The anterior wall is then sutured with the peritoneum; then the posterior peritoneum and posterior vaginal wall. It may require a few similar stitches, depending on the size of the wound, leaving a small opening in the center for the iodoform gauze drain.

Repair of a cystocele or a rectocele, or perineorrhaphy, if required is usually performed at the same time; but if the patient can not tolerate so much surgery at one time, then the repair can be done seven to ten days later, under a gas anesthesia. Before the patient leaves the operating room a retention catheter is inserted into the bladder.

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SINGLE INCISION, TRANSABDOMINAL, EXTRAPERITONEAL APPROACH TO LUMBAR GANGLIA

CLARENCE E. REES, M.D., F.A.C.S.

Chief, Division of Surgery, Rees-Stealy Clinic; Surgical Staff, Mercy and San Diego County General Hospitals

SAN DIEGO, CALIF.

THE selection of an incision through which to reach a given site of operation requires the careful consideration of three factors all of which are important to both the patient and the surgeon: (1) there must be adequate exposure so that the necessary procedure may be performed with dispatch and precision; (2) there must be a minimal destruction of important structures so that a reconstruction of the wound with unimpaired functional results is assured; (3) there must be minimal manipulation of structures the exposure of which might cause later complications.

The diverse opinions of qualified surgeons as to the proper approach for operations on the lumbar sympathetic ganglia indicate that a completely satisfactory approach to this field has not been described. If operations on these structures were always unilateral the problem would be more simple but since the abnormal conditions which involve the structures influenced by these ganglia are frequently bilateral it becomes necessary to attack the ganglia on each side at a single operation.

We have avoided the lumbar incision described by Royle[1] for operations on the lumbar ganglia because we observed that the exposure thus obtained did not give as free an access to the ganglia as could be obtained by the transperitoneal approach. An incision from the side gives a deep operative field with definite limitation of extension in the posterior limb of the incision. As a result, access to the lower ganglia is sometimes difficult since these ganglia follow the spinal contour, and bleeding caused by injury to the veins which overlie the ganglia on the right is more difficult to control than when exposure is more adequate. Furthermore, lumbar incisions require separate preparation of two operative fields and alteration of the position of the patient when changing from one side to the other, all of which lengthens the time of surgery and anesthesia.

The transperitoneal approach through a midline incision described by Adson[2] gives ample exposure and, if necessary, can be extended in either limb in the line of the structures being operated. However, in spite of extreme care in handling the intestines, we have had a great deal of postoperative discomfort, as ileus, etc., in a large percentage of cases in which this approach was used. In 3 cases intestinal obstruction which required operation for relief developed. In 2 of these cases the obstruction occurred before the patient left the hospital and in the third case, several months later. In this last case, operative intervention which was performed elsewhere, resulted fatally. In all 3 cases the obstruction was caused by adhesion of the small intestine to the posterior peritoneal incision, in one on the right side and in 2 cases on the left side. A procedure which carries this hazard should be eliminated if possible.

An anterior extraperitoneal approach to these ganglia has been described recently.[3] This is a lateral approach through a muscle splitting incision, which again necessitates two incisions with resulting change of

position of the patient and does not permit extension of the incision in the line of the ganglia.

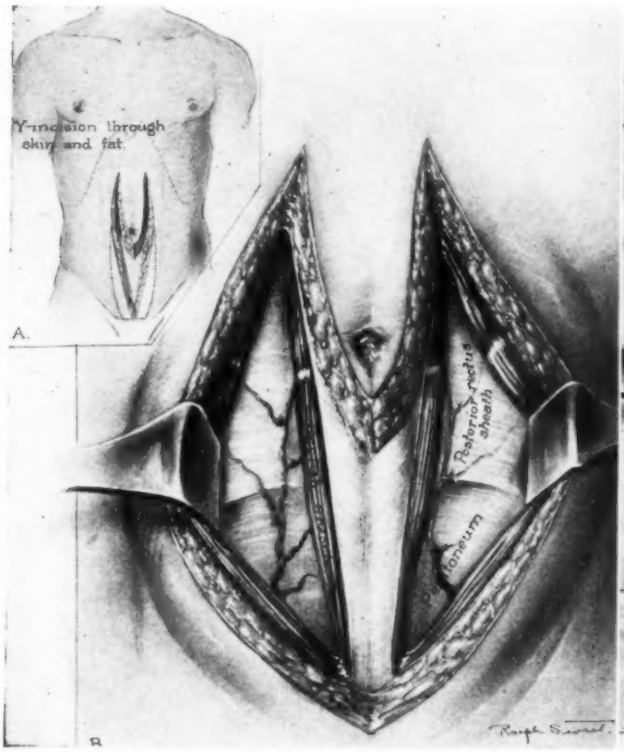

Fig. 1 A. Y-incision through skin and fat. Dotted lines indicate areas of separation of deep fascia from rectus sheaths. If operation is to be unilateral, the incision swings only to the side of the umbilicus on which the operation is to be performed. B. Incision of rectus sheath and rectus muscle on each side exposing the peritoneum in the lower part and the posterior sheath in the upper part of the incision. If the operation is unilateral, the rectus sheath on that side only is opened.

Fig. 2. Incision of posterior rectus sheath. This incision does not extend through the peritoneum.

Because of the disadvantages of these previously described incisions for this type of surgery, we have developed an incision which gives an exposure equal to that of the transperitoneal approach and eliminates entirely the direct handling of the intestines. It is a single skin incision requiring but one preparation and its closure is effected in a manner which, for a number of years, has been found satisfactory for lower abdominal incisions. This approach consists of a Y incision through the skin and fat and a longitudinal incision through each rectus muscle to, but not through, the peritoneum. This combination makes a bilateral incision through the deeper structures which permits the exposure of the ganglionated chains in a manner that avoids the less desirable features of the other methods of approach.

The type of anesthesia is optional with the surgeon but it should be adequate for surgical relaxation. Surgical preparation of the abdomen is made from the nipples to the thighs.

A low midline incision through the skin and fat is made from the symphysis pubis to one inch below the umbilicus. At this point the incision is developed into a Y with limbs extending upward on each side of the umbilicus over the inner one-third of the rectus muscle to a point midway between the xyphoid and the umbilicus. (Fig. 1 A.) In the lower part of the incision the deep layer of superficial fascia is separated from the inner halves of the rectus sheaths on each side to a point that is in the same lateral plane as the upper limbs of the incision. A longitudinal incision is made in each rectus sheath so

that one-third of the muscle lies medial and two-thirds lateral to each incision. The rectus muscle is then incised in this muscle, thus carrying the dissection inward, this separation is accomplished easily.

FIG. 3. Separation of posterior rectus sheath from peritoneum.

FIG. 4. Retraction of the peritoneum with its contents, left side.

same plane thus carrying the exposure down to the posterior sheath of the rectus in the upper three-fourths and to the peritoneum in the lower one-fourth of the incision. (Fig. 1 B.) The deep epigastric artery which lies on the posterior sheath and on the peritoneum is then in view and any bleeding vessels are ligated. The posterior sheath is separated from the peritoneum by inserting the finger between these structures lateral to the outer border of the rectus muscle. This separation is carried inward toward the midline by digital dissection. The posterior sheath, not the peritoneum, is then incised lateral to the deep epigastric artery leaving the artery on the medial side of the incision. (Fig. 3.) This method of separation of the peritoneum from the posterior sheath is one of the important points of this operation. If such separation is started in the line of incision, the peritoneum is very likely to be opened, whereas, if the line of cleavage is entered lateral to the rectus

The patient is then placed in the low Trendelenburg position.

The peritoneum which has been exposed by incision of the posterior sheath is separated laterally from the abdominal fascia (Fig. 4) and, with its abdominal contents, is retracted gently toward the opposite side until, on the left the aorta and iliac vessels, and on the right the vena cava and iliac vessels are exposed. At this point the peritoneum is held by deep retractors, or preferably, the assistant's hand, over gauze and the operation of choice on the sympathetic chains is performed. (Fig. 5.)

Accidental opening of the peritoneum does not carry the hazard involved in a similar approach in cases of operations upon infected ureters. Such an opening occurring during the extraperitoneal approach to the ganglia may be closed at once or after completion of the operation depending upon whether or not retraction tends to increase the size of the rent.

Closure is effected in layers using single continuous chromic catgut sutures in the posterior sheath and in the muscle, and single interrupted chromic catgut sutures with simple square knots in the anterior sheath. This latter suture is reinforced with figure-of-eight silkworm retention sutures. In the branching limbs of the incision the usual figure-of-eight sutures are used. In the single limb of the incision the lower loops of these sutures alternate on opposite sides of the fascial incisions, that is, one suture passes through skin and fat and loops through the right rectus sheath to exit through the fat and skin on the other side, while the next suture passes through the skin and fat and loops the left rectus sheath to emerge through to the fat and skin. One end of each superficial loop of the figure-of-eight sutures, after emerging from the skin is passed again through the margins of the skin incision so that when the tie is made it is to one side of the skin incision. This leaves two loops of silkworm gut above the skin, one on each side. Rubber tubing is then passed under these loops on each side and the sutures are tied over these tubes so that the dead space within the incision is obliterated. The skin is closed with clips.

CONCLUSIONS

A transabdominal, extraperitoneal approach to the lumbar ganglia is described which we have found superior to other methods of approach in that adequate exposure of the ganglia on both sides is obtained and direct handling of the intestines is avoided.

Fig. 5. Peritoneum retracted and the lower lumbar ganglia exposed, left side.

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LOW MORTALITY OF EARLY OPERATION FOR PERFORATED GASTRIC AND DUODENAL ULCER

BENJAMIN T. TILTON, M.D., F.A.C.S.

Director of Surgery, Broad Street Hospital

NEW YORK CITY

PROMPT surgical intervention in the face of sudden perforation of a gastric or duodenal ulcer has been the established practice for many years and countless lives have been saved which would have been sacrificed by delay and symptomatic treatment. But even at the present time delay still contributes to maintaining the mortality of this serious complication of ulcer at a much higher point than it should be. In some cases delay is excusable; in others it is not. Early diagnosis is of course indispensable and in most cases should be easily made from the characteristic and dramatic onset of the symptoms and the objective findings. In a few hours the diagnosis may be more difficult on account of the subsidence of the early symptoms and a resulting latent period before the development of peritonitis. After peritonitis is established, its point of origin cannot be diagnosed with the same accuracy as at the onset of the perforation, and hence the site of the abdominal incision is not always properly selected. Distance from a surgical center, requiring long transport and delayed consent for operation, may account for the sacrifice of many precious hours between perforation and operation. It is the number of these intervening hours that is the most important factor in the mortality rate. I think that it can truthfully be stated that with proper surgical technique and judgment and the absence of unexpected complications, the mortality of perforated gastric or duodenal ulcer should be practically zero if the patient comes to the operating table within twelve hours after perforation. After twelve hours delay becomes increasingly more serious for the prognosis; after twenty-four hours the mortality mounts still more rapidly. After thirty-six hours operation is rarely successful and it is probably better judgment to abstain from operation and rely on natural reparative processes which, in isolated instances, have been known to bring recovery. Apart from delay, poor surgical judgment and technique will of course always keep up the general mortality rate even in early cases.

In 52 cases operated at the Broad Street Hospital during the past five years I have had the opportunity of observing a practical demonstration of the excellent results that follow when the patient with a perforated gastric or duodenal ulcer is brought promptly to the surgeon. Delay has been at a minimum in these cases, as the hospital is situated in a very condensed area which is populated only during the day and chiefly by office personnel. Intelligence above the average on the part of this temporary day population and very short transportation to a hospital, equipped for and accustomed to sudden demands of emergency cases give these cases of perforation their best chance. In this series of cases the average time elapsed between the onset of the acute signs of perforation and the start of the operation was only six hours.

Study of the records of these cases brings out other factors of interest, some of which undoubtedly help to explain the absence of mortality of the series traceable to the perforated ulcer or the operation.

Age. The youngest was twenty years, the oldest fifty-three years with the average

thirty-six years; patients of early and middle life, a favorable period for operation and repair.

Sex. There were 50 males and only 2 females. This excessive preponderance of males in the series is due, not only to the greater susceptibility to perforation of males in general but also to the fact that the district in which the hospital is located has a much larger daily male population. This predominance of males probably does not influence the mortality following operation.

Occupation. In 50 cases in which the occupation was given there were 33 of the sedentary class, including clerks, stenographers, telegraph operators, bookkeepers, salesmen, etc. There were 17 whose work was more strenuous, such as porters, deck hands, elevator operators, restaurant employees, etc. As already stated the higher average of intelligence in the majority of the cases as compared with the tenement classes insures prompt resort to medical aid and early consent to operation.

Site of Perforation. In 46 cases the operative records stated that the perforation was on the anterior surface of the stomach or duodenum at or near the pylorus. In one case it was on the anterior wall halfway between the pylorus and cardia. In 3 cases it was on the posterior wall, one being at the site of a posterior gastro-enterostomy. In 2 cases the site of perforation was not recorded. In 23 cases the site of the ulcer was stated to be prepyloric, in 18 cases postpyloric and in 5 cases the general term "pyloric region" was used. These figures support other statistics and are probably more striking in their high percentage of perforations near the pylorus on account of the excessive male element in the series. From my experience I am inclined to believe that postpyloric perforations are much more common, in males at least, than prepyloric. It is possible that through inaccuracy in observation a postpyloric perforation may be recorded as prepyloric. Such a mistake is easily made unless one pays special attention to the differentiation.

The operative procedure employed in this series was, with slight variations, uniform. Exposure of the pyloric region was followed by aspiration of the fluid contents of the peritoneal cavity and suture of the perforation. One or more layers of purse string or Lembert suture, usually of chromic catgut, were used to close and infold the small perforation. Suture of omentum over the infolding suture is desirable. The methods of drainage varied and were as follows:

1. A strip of rubber tissue drain to the area of suture;
2. Drainage of Morrison's pouch;
3. Drainage of pelvis through a small secondary incision above the pubis or in the right lower quadrant;
4. Rubber tissue drain to the sutured peritoneum only;
5. No drainage.

In my opinion intraperitoneal drainage is not necessary or desirable in the early cases. Rubber tissue drainage down to the sutured peritoneum is my practice in all cases, on account of possible infection of the subcutaneous tissues from the peritoneal exudate. For this reason I approximate the skin and subcutaneous tissues with interrupted silkworm gut or dermal, and do not use coaptation sutures for the skin edges. In this way infection of the wound and its unfortunate sequelae can be avoided.

In no cases was a gastro-enterostomy or other secondary operation performed. In my opinion such prolongation of the operation is most unwise. The main object should be to save the patient's life and therefore "get in and out" as quickly as possible. It is far better to postpone to a later time any further operative procedure when a proper choice of operation can be made, based on *x*-ray or other studies. In many cases the ulcer can be healed by postoperative medical treatment. For this reason these patients should always be referred to the gastro-

enterological department of the hospital as soon as they have recovered from the operation.

There is a great tendency in the European surgical clinics, notably the German and the Austrian, to perform gastric resection in place of simple suture of the perforation. Gastro-enterostomy has been largely discarded by them in these cases just as it has been in the non-perforated ulcers. Some clinics have recorded a mortality rate as low as 5 per cent in selected cases of gastric resection, i.e., in those operated within twelve hours and whose general condition is satisfactory. This radical method is justified by these surgeons on the ground that the perforated ulcer and possibly one or more secondary ulcers are removed by the resection and thus a later operation or prolonged medical treatment is avoided. Furthermore, they claim that their enormous experience in gastric resection in all types of ulcers has so perfected their technique, that the operation can be done very rapidly, i.e., in forty-five minutes, and hence with little additional shock. In spite of these arguments I feel that a mortality of practically zero in cases operated early by simple suture can never be equalled by the method of gastric resection, certainly not if it becomes routine among surgeons with their varying proficiency in performing the radical operation. Another consideration is that many, if not most of the cases operated by simple suture will never require the secondary radical operation. It seems hardly fair to subject all cases to the risk of a resection when only a moderate percentage of them might need it at a future time. In trying to rid the patient of his ulcer at the time of the emergency operation the surgeon is attempting too much and the risk involved in changing from a no mortality procedure to a hazardous radical one is not justifiable.

Most of the cases in this series ran a smooth postoperative course. The various complications were as follows:

Infection of wound 12 cases.
Bronchopneumonia 6 cases.
Femoral phlebitis 1 case.
Cerebral embolism 1 case.
Bilateral suppurative parotitis 1 case.

There was only one death in the series and that was caused by cerebral embolism. This occurred on the ninth day in a patient forty-six years old who had entirely recovered from the operation and was about ready to get out of bed. All the other cases with postoperative complications recovered completely. Were it not for the unforeseen and unavoidable death from cerebral embolism this series of 52 cases would have had a mortality of Zero. As already stated this should be the case in any series in which the patient is operated within twelve hours under favorable conditions and unavoidable complications do not occur.

I am indebted to the chiefs of the other surgical divisions of the hospital for the privilege of including their cases in this report.

SUMMARY

1. Prompt surgical intervention is vital in cases of perforated gastric and duodenal ulcer.

2. If the period between perforation and operation is twelve hours or less, the mortality should be practically nil under favorable conditions and in the absence of unavoidable complications. In this series of cases the elapsed time averaged only six hours.

3. In about 90 per cent of the cases the perforation was on the anterior wall.

4. Operation should consist of simple closure with chromic catgut and suture of the omentum over the site of perforation. Immediate radical operation such as partial gastrectomy is unjustifiable.

5. Intraperitoneal drainage is not necessary or desirable in the early cases.

6. There was only one death in this series and that was due to an unavoidable complication, cerebral embolism on the ninth day.

DELAYED OPERATION IN ACUTE CHOLECYSTITIS*

REPORT OF 134 OPERATIONS ON THE BILIARY TRACT, COVERING A PERIOD OF FIVE YEARS

HUGH L. BASS, M.D., AND CLARENCE E. BIRD, M.D.

LOUISVILLE, KENTUCKY

THIS article deals with the immediate results of surgical treatment of diseases of the biliary system as performed in the Louisville City Hospital during the five year period between January 1, 1930, and January 1, 1935. The operations were performed on a general surgical service by twenty-five different surgeons. Although the patients belonged to the less fortunate groups of individuals in the community, it cannot be said that they were less favorable risks, from a surgical standpoint, than the average seen in practice.

During the five year period, 142 operations were performed on patients in whom preoperative diagnoses of diseases of the biliary tract had been made. In 6 instances the preoperative diagnoses were found to be erroneous and were corrected at operation as follows: in 2 cases, carcinoma of the head of the pancreas; in one each, cirrhosis of the liver, catarrhal jaundice, "enlarged liver," and retroperitoneal lymphosarcoma. In 2 other cases no disease was found in the biliary system or elsewhere. These latter 8 cases have been removed from the series, and only the remaining 134, in which actual diseases of the biliary tract were verified either at the time of operation or in the pathological laboratory, are considered in the remainder of the report.

The distribution of the cases was as follows: females 105, males 29; white 105, colored 29. The youngest patient was seventeen years old, and the oldest sixty-eight; average 42.5 years. The mean duration of symptoms was three years and five months. Eighty-four of the females had an average of 4.6 pregnancies, 4 were nulliparous, and in 17 cases no information as to parity was available. In 23 of the 134 histories, the statement was found that the patient had had typhoid fever, but in many instances there was no information one way or the other. Sixty-five per cent of the patients were obese, 24 per cent average in weight, and 5 per cent undernourished. No statement as to the physical type was found in 8 of the histories. Nine of the patients had been subjected previously to operations upon the biliary tract, which were, with one exception, cholecystostomies.

Cholecystograms were made in 75 per cent of the cases, mostly by the oral method. Whenever the roentgenologist made a positive diagnosis of cholecystic disease by this method, the findings at operation were confirmatory. On 4 occasions when the cholecystograms were read as normal the operators discovered chronic cholecystitis without stones, and in one case, chronic cholecystitis with calculi in the gall bladder.

Chronic cholecystitis with stones in the gall bladder (in 8 of these cases there were also stones in the common bile duct)	73	
Chronic cholecystitis without stones (in one of the cases there was also a stricture of the common bile duct)	49	
Total cases with chronic cholecystitis		122
Acute cholecystitis with stones in the gall bladder (in 3 of these cases there were also stones in the common bile duct, and in 4 cases the gall bladder was ruptured)	6	
Acute cholecystitis without stones	4	
Total cases with acute cholecystitis		10
Carcinoma of the gall bladder		2
Total cases		134

The operative procedures were divided as follows: cholecystectomies 117, cholecystostomies 12, choledochostomies 31. Obstruction of the common duct was found in 12 cases in which the duct was explored. Stones caused the obstruction in 11 instances; in one case it was due to the formation of scar tissue as the result of a previous operation. The exact nature of

* From the Department of Surgery, Louisville City Hospital, and the University of Louisville School of Medicine.

this operation is unknown but the gall bladder was not removed. The average stay in the hospital following the 134 operations was 19.9 days.

The pathologic changes were as shown on page 241.

The hospital mortality rate was 4.5 per cent. Abstracts of the histories of the 6 patients who died, accompanied by comments on their management are recorded.

Case 1. A colored porter, aged forty-seven years, complained that two days previously he had onset of pain localized near the umbilicus for the first two to three hours, after which it moved over to the region just beneath the right costal margin. He vomited once, took magnesium sulphate, and vomited again. The pain became progressively worse and did not radiate. He had no previous attacks of abdominal pain. The patient had been subject to bronchial asthma for fifteen years and had had typhoid fever.

Examination showed the patient to be in much discomfort, temperature 101°F., pulse rate 120 and respirations 24. There was muscle spasm over a tender mass below the right costal margin. His white blood count was 15,000 cells with 89 per cent polymorphonuclear leucocytes. His urine was normal.

Emergency operation under spinal anesthesia was done. The gall bladder was found to be distended, discolored and apparently gangrenous in spots. It contained about 40 cm. of bile stained fluid and no stones. A catheter was inverted into the fundus; cigarette drain left in the wound.

Postoperative course was stormy. The temperature rose to 104°F., the pulse to 136, the abdomen became distended, the patient became dyspnoeic, irrational and comatose, and died on the second postoperative day. Permission for a postmortem examination was refused, but the causes of death were considered to be acute generalized sepsis, paralytic ileus and hepatic insufficiency.

Comment: Cases of this nature question the advisability of operation in the acute stage of gall-bladder disease. The authors believe that this patient should have been left quiet for ten days to three weeks before operation. During such an interval the daily administration of glucose would have fortified the liver against insufficiency and the infection would almost certainly have receded into a subacute or chronic localized state.

The record indicates that the diagnosis was indefinite and that acute inflammation in a superiorly placed appendix was suspected. Under these circumstances exploration was indicated, but unless perforation was imminent or acute pancreatitis had been present we believe that the gall bladder should have been left alone and that the abdomen should have been closed without drainage. In other words, having determined that the appendix was innocent and that the gall bladder was simply acutely inflamed, the patient would have stood a better chance for recovery if the removal of the gall bladder had been left for a second stage when there was less infection and when the preparation of the patient had been adequate perhaps two or three weeks later.

The operative note in this case states that the operator considered the wall of the gall bladder to be "gangrenous in spots." It is our opinion that very few indeed of these gall bladders will actually rupture if left alone. In a questionable case the omentum should be wrapped around the gall bladder but unless perforation is obviously about to occur we believe neither a cholecystostomy or a cholecystectomy should be performed.

Case 11. A white widow, aged sixty-six, was admitted to the medical ward complaining of pain in the right upper quadrant of the abdomen. At irregular intervals for eight to ten years she had had severe pain below the right costal margin with radiation to both scapula and intolerance to fried foods, but she never had any jaundice. She had seven pregnancies. Onset of the present attack was the day previous to admission.

Patient very obese and quite ill. Temperature 100.3°F., pulse rate 105, respirations 30. Marked muscle spasm and tenderness were elicited just below the right costal margin. The blood count revealed 7,650 leucocytes with polymorphonuclear leucocytes 65 per cent, erythrocytes 3,580,000, hemoglobin 75 per cent. The urine was normal. Icterus index was 5 and non-protein nitrogen 31.5 milligrams.

The patient improved on rest in bed so that the following examinations could be made.

A film of the chest showed considerable cardiac enlargement and cloudiness throughout the left lung field with mottling on the right. Left axis deviation was demonstrated by an electrocardiogram. A gastrointestinal series indicated 20 per cent retention of barium in the stomach at six hours; no organic change was demonstrated, however. The gall bladder was not visualized in cholecystograms.

Glucose was administered intravenously for two days before operation. A contracted, chronically thickened gall bladder which contained a small amount of pus and one stone was removed. The pathologic diagnosis was chronic cholecystitis with extensive fibrosis and cholelithiasis.

The patient never rallied and died on the following day with a temperature of 106°F., pulse of 120, respirations 28. The clinical impression was hepatic insufficiency.

Comment: In evaluating this case it would be desirable to know more of the details of the operation itself than appear on the chart. However, there is no reason to believe that there was undue trauma, spillage of infected material into the peritoneal cavity or that there were difficulties with the anesthesia. It seems likely that this patient falls into that class of patients with chronic liver damage who would be greatly fortified by prolonged treatment with glucose. It will be noticed that in spite of the fact that she was studied on the wards for two weeks, glucose was administered for only two days preoperatively, an entirely too short period of preparation for any patient with cholecystitis.

Case III. A white widow, aged fifty-eight gave a history of ten pregnancies and a cholecystomy twenty-one years previously for the relief of severe right upper quadrant pain and vomiting. Since shortly after her operation she had had chronic dyspepsia and recurrent attacks of pain with vomiting, often accompanied by an icteric tinge of the skin and sclera. The present attack began the day before admission.

The patient was obese, slightly jaundiced, in pain, with tenderness and muscle spasm in the right upper quadrant of the abdomen in the region of the old operative scar. The blood findings were: white blood cells 7,350, polymorphonuclear leucocytes 82 per cent; icterus index 60, and negative Wassermann reaction. Urine was normal. Her temperature ranged from 99.4°F. to 102°F., pulse rate 70, respirations 20 and the blood pressure was 120/70.

At operation, eight days after admission, while still febrile, a fistulous tract which led from the abdominal scar to the fundus of the gall bladder was excised. About one ounce of brownish fluid and three stones were removed from the thickened organ. No calculi could be palpated in the common bile duct and it was not opened. A catheter was sewed into the fundus and a cigarette drain was placed nearby.

The patient drained well through the catheter and from the wound, but the pulse rate remained moderately elevated and she died, with a terminal rise in temperature, on her twelfth postoperative day. The clinical impression was subacute and chronic hepatitis with hepatic insufficiency, generalized sepsis and bronchopneumonia.

Comment: Here again, it is difficult to evaluate the case without more information and an autopsy. The authors suspect, however, that the preparation of the patient was inadequate and that her chances of recovery would have been increased greatly if glucose had been administered for ten to twenty days and if the then less acutely inflamed gall bladder had been removed instead of drained. It is possible also that the common bile duct should have been explored and drained. There is no doubt but that adequate preparation would have increased the safety of that procedure. Certainly it was inadvisable to operate on this patient while she still had a fever of 101°F.

Case IV. A white laborer, aged sixty-four was seized six hours before admission with abdominal pain, nausea, and vomiting, which occurred only twice. The pain became more constant and centered in the pit of the stomach. The bowels had moved once since the onset. An incisional hernia, which arose following an appendicectomy performed two years previously, had grown progressively larger, but had caused no discomfort.

There was an old right rectus scar with subcutaneous protrusion of a mass of small intestines, 20 × 20 cm., but no visible peristalsis and no demonstrable incarceration. Tenderness was generalized over the mass, over the left side of the abdomen, and in the epigastrium. Rectal examination was negative. His temper-

ature was 98°F., the pulse rate 92, respirations 32; the blood pressure was 170/130, and the white count was 19,750 with ploymorphonuclear leucocytes 93 per cent. The urine showed a specific gravity 1.019, trace of albumin and many pus cells.

At operation, performed shortly after admission, the intestinal loops were freed insofar as was necessary in order to enter the abdominal cavity. No obstruction which could account for the symptoms was found, but an enterostomy tube was placed in one of two small holes torn in the bowel during the dissection. The gall bladder was tense, edematous, and packed with calculi. It shelled out of the liver bed with ease and was removed. A drain was placed through a stab wound, and closure was carried out in two layers without attempting to repair the hernia completely. The pathologic diagnosis was chronic cholecystitis with cholesterosis and cholelithiasis.

The patient's condition was critical shortly after operation. In spite of the use of an oxygen tent, digitalis and intravenous glucose, he became cyanosed, the respirations were labored, signs of extensive pulmonary edema developed, and he died thirty hours after operation, presumably of acute bilateral pulmonary edema and bronchopneumonia.

Comment: It is obvious that the gall bladder should not have been removed at the time. The patient had been in the hospital only a few hours and was inadequately prepared for cholecystectomy. The accidental opening of the small bowel in freeing the adherent loops within the hernial sac should have limited further operating to a minimum, of course. It cannot be determined whether or not hepatic insufficiency had anything to do with this fatality, but from the standpoint of glycogen reserve the patient was not properly prepared for cholecystectomy.

Case v. A colored domestic, aged forty-nine, was admitted complaining of pain in the right upper lumbar region for three days, and in the right lower abdomen with nausea and vomiting for eighteen hours. Recently she was constipated. There were no previous indigestion or attacks of abdominal pain. She had been in a wheel chair most of the time for three years because of weakness of the legs. There was a neurotic background.

A moderately obese, rather acutely ill negress, temperature 100°F., pulse rate 112, respirations 24, blood pressure 198/110, not jaundiced. The eyes showed bilateral early cataracts and arteriosclerotic changes in the fundi. The thyroid gland was adenomatous. The abdomen was spastic on the right with tenderness most marked over a mass in the region of the gall bladder. The uterus was enlarged and nodular. Symmetrical weakness of the muscles of legs was present but without paralysis or anesthesia and the knee jerks were sluggish. There were 11,850 white blood cells, polymorphonuclear leucocytes 79 per cent, red blood cells 4,210,000, hemoglobin 75 per cent. The urinary findings were: specific gravity 1.002, slight trace of albumin, no sugar and the sediment showed a few pus cells. Phenosulphonephthalein excretion was 65 per cent in two hours. Blood and spinal fluid Wassermann reactions were negative; spinal fluid mechanics normal. Icterus index was 17 and non-protein nitrogen 25 mgs. Basal metabolic rate was minus 11.

X-ray films showed deviation of the trachea by the thyroid adenoma, moderate cardiac enlargement, extensive hypertrophic arthritis of the lumbar spine, and calcification in a fibroid uterus. The gall bladder could not be demonstrated in cholecystograms made by the intravenous method. A barium enema was negative.

Following the administration of glucose daily during an afebrile period of four weeks, a tense gall bladder, moderately thickened and packed with stones, was removed. The common duct was normal and was not explored. Incidental appendicectomy was performed and abdominal closure was done with drainage. The pathologic diagnosis was chronic cholecystitis and cholelithiasis. A culture from the gall bladder showed no growth.

The patient was apathetic; tachycardia, low grade fever, persistent distention, and vomiting of small amounts of bile stained material occurred in spite of the presence of a tube placed intranasally into the stomach. Cultures from the drainage tract grew a hemolytic streptococcus. Returns from enemas were scanty. Left rectus exploration under procaine anesthesia on the sixteenth day after cholecystectomy was done to rule out partial intestinal obstruction or residual abscess; neither was found, nor was there any evidence of a subphrenic abscess. Urinary output was satisfactory. She was transfused. The patient became comatose and died, following a rise in temperature, nineteen

days after the original operation. Clinical impression: extensive cardiovascular disease with hypertension, hepatic insufficiency, terminal bronchopneumonia.

Comment: This patient was operated upon by one of the authors (C.E.B.). In the absence of an autopsy no definite explanation of the fatality seems possible. There was no jaundice and no extensive renal damage. It is unfortunate that tests of the hepatic function were not done before and after the lengthy preoperative course of glucose therapy. A biopsy of the liver was not made. It is possible that the liver was badly damaged and that the response to treatment with carbohydrates was insufficient.

Case vi. A white watchman, aged sixty, had had pain for three days in the lower abdomen and in the costovertebral angles, bilaterally, but no nausea or vomiting. During this time he had been unable to void more than two or three tablespoonfuls of urine daily, and his bowels had not moved. He had no previous attacks of abdominal pain. He had had typhoid fever many years ago.

The patient appeared drowsy. There was moderate muscle spasm and diffuse tenderness in the right lower quadrant of the abdomen. An *x*-ray film showed a great deal of intestinal distension with the pattern of the colon well outlined. His temperature was 96°F., pulse rate 75, respirations 22, blood pressure 90/75; leucocytes 13,750, polymorphonuclear leucocytes 90 per cent and nonprotein nitrogen 30.3 mgs. Urinalysis showed trace of albumin, sugar negative, occasional pus and red blood cells in the sediment. The differential preoperative diagnosis was acute suppurative appendicitis or perforated peptic ulcer with generalized peritonitis and paralytic ileus.

Exploration shortly after admission revealed a large amount of yellow pus in the right colonic gutter originating from a partially gangrenous and perforated gall bladder which contained many small stones and much muddy material. The intestines were distended. A catheter was sutured into the gall bladder and the abdomen was closed with drainage.

The postoperative course was septic. He was irrational most of the time, greatly distended, and on the eleventh day developed a fecal fistula in his gaping, infected wound. He died on the thirteenth postoperative day. An autopsy, which was limited to inspection through the wound of operation, showed a perforation of the ileum at the site of the partially separated wound, localized peritonitis, acute suppurative cholecystitis, cholelithiasis with obstruction of the cystic duct, acute degeneration of the liver and other viscera, and a diverticulum of the duodenum. The common duct was patent and contained no stones.

Comment: This patient was so acutely ill that recovery could not be expected except under the most favorable conditions. The rupture of the wound and strangulation of a loop of ileum were complications which could not be survived. The notes indicate that the patient was too ill to stand secondary suturing of the wound and that the infection of the wound made the advisability of resuturing problematical. All in all, in the face of a ruptured gall bladder and intestinal distention at the time of operation, it is not justifiable to criticize this fatality adversely.

DISCUSSION

It should be noted that in 5 of the 6 fatal cases the patients were inadequately prepared for operations on the biliary tract. In 4, a delay in the drainage or removal of the gall bladder was possible and during that time glucose could have been administered; also in 3 cases the acute inflammation in the gall bladder could have been allowed to subside. In only one instance, in which there was a ruptured gall bladder, did the situation require emergency operation on the biliary tract without adequate preparation. Much has been written about the thorough preparation of jaundiced patients for operation, but the authors feel that insufficient emphasis has been placed on the careful preparation of patients with acute and chronic cholecystitis in the absence of jaundice. Graham,[1] was able to reduce sharply the mortality rate in biliary diseases in his clinic by insisting on the preoperative administration, except in emergency cases, of glucose for ten or more days whenever the retention of phenoltetraiodophthalein was more than 50 per cent in one-half hour. A simple substitute for this plan, which we have used,

is to carry out the treatment with glucose in all elective cases without resort to the test. In private practice, many patients are able to take the glucose by mouth in the form of candy or orange juice before hospitalization while they are ambulatory or in bed at home. The safest method, however, is to repeat the test until the retention decreases to within normal limits. We feel that this should have been done in Case v, and that operation might have been contraindicated on the basis of persistent retention of the dye even after several weeks of therapy with glucose.

The authors believe that patients with acute cholecystitis should not be operated upon unless there is evidence of rupture of the gall bladder or acute pancreatitis. With these complications constantly in mind the patients should be kept under careful observation with a high carbohydrate intake. A very large proportion, at least 90 per cent, become asymptomatic and free from fever within two weeks and can then be operated upon with safety. If a patient is operated upon as an emergency, either under a mistaken diagnosis or because of the fear of a ruptured gall bladder or an acute pancreatitis, and simple acute cholecystitis is found, we believe that the abdomen should be closed immediately, without cholecystostomy or cholecystectomy or drainage of the peritoneal cavity. The inflammation should be permitted to subside spontaneously so that the gall bladder can be removed subsequently in a quiescent state after adequate preparation with glucose. It is recognized that there occurs rarely a case in which at exploration rupture of the gall bladder obviously is imminent. In this circumstance the gall bladder requires drainage or removal, but in the simple acute and doubtful cases the authors believe that the omentum should be wrapped around the gall bladder and that it should be left alone.*

SUMMARY

Operations for diseases of the biliary tract were performed in the Louisville City Hospital by twenty-five surgeons on 134 patients during the five year period between January 1, 1930, and January 1, 1935. The mortality rate was 4.5 per cent. Although this figure is fairly satisfactory, the authors feel that several of the fatalities could have been prevented by delayed operations and adequate preparation with glucose over a ten day to three week period.

Delayed operations are recommended in cases of acute cholecystitis. It is believed that by careful observation the onset of perforation or acute pancreatitis can be detected and proceded against promptly if either occurs. If at the time of an emergency operation under a mistaken diagnosis a simple acute cholecystitis without imminent perforation is encountered, it is recommended that the omentum be wrapped around the gall bladder, the abdomen closed without drainage and the gall bladder be removed ten days to three weeks later after subsidence of the acute inflammation and after adequate preparation with carbohydrates.

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* Those who are interested in articles in which are reported larger series of cases should refer to the papers of Blalock,[2] Hitzrot and Cornell,[3] Judd and Parker,[4] and Fowler.[5] At the Johns Hopkins Hospital, Blalock found that the proportion of white to colored patients who were seen with diseases of the biliary tract was 32 to 1, whereas the proportion of white to colored patients on the surgical service as a whole was 5 to 1. That meant that the white patients were afflicted with diseases of the biliary tract about six times as often as the colored patients. In our shorter series the difference is less striking, the proportions being, respectively, 3.6 to 1, and 1.7 to 1, so that the white patients had diseases of the biliary system 2.2 times as often as the colored patients.

NON-PADDED PLASTER CAST FOR LOWER EXTREMITY*

R. A. GRISWOLD, M.D., F.A.C.S.

Associate Professor of Surgery. Surgeon, Louisville City Hospital.

LOUISVILLE, KY.

TRACTION and suspension methods with such accessories as the Thomas splint have played a predominant part in the development of the modern treatment of fractures. Their evolutionary importance cannot be over-emphasized, though they have, however, certain deficiencies. The patient must be immobilized to obtain immobilization of the broken bones and is neither ambulatory nor portable. Constant checking and readjustment of the apparatus is required, for even though good position may be obtained at first, subsequent displacement is not uncommon. Hospitalization which is a considerable factor in these times of economic stress is prolonged. Considerations such as these have led to the development of more efficient procedures, notably by Boehler[1] in Europe and by John Caldwell,[2] Roger Anderson,[3] and others[4] in this country. Traction-suspension methods may now be replaced to a large extent by more efficient means of reduction followed by fixation in plaster of Paris, which is the most satisfactory dressing for most fractures. Often fixed traction, or to use a better term, skeletal fixation in plaster, is advantageous. Plaster splints or casts are made to fit the individual with accuracy impossible to attain by other means. They offer better control of position and are more comfortable than any metal or wooden splint. The patient is comfortable, ambulatory or at least portable and final anatomical and functional results are good. Skillful application of a suitable retention dressing is equally as important as a good reduction of the fracture.

The technique of plaster fixation has been neglected in recent literature. Most authors writing on the newer methods of treatment treat the subject lightly and chapters devoted to splints and casts in the new textbooks are inadequate and outmoded. This is especially true of the use of non-padded plaster. The monographs of Boehler[1] and Schnek[5] are almost the only exceptions. Lack of appreciation of the theoretical and practical considerations involved in the proper use of the plaster dressing, in particular the non-padded variety, has contributed to the widespread failure to realize its advantages and possibilities.

Advantages of Non-padded Plaster Casts. The non-padded plaster cast has numerous advantages over the conventional padded casts, the most important is that fixation is incomparably more secure. Padding, no matter how skillfully applied, is subject to compression and thinning with an increase of the space between the skin and the cast, inevitably leading to looseness and motion within the cast. In some fractures this motion may cause nothing more disastrous than a spasm of pain each time the limb is moved until the formation of callus stops the painful grinding of the fracture surfaces. In others, especially those which are comminuted or which involve joints, motion of the atrophied, functionless limb in a loose padded cast may result in shortening, deformity or disabling mal-alinement of the joint surfaces. This is particularly true of fractures of the shaft of the femur, the condyles making up the knee, the mortise of the ankle and the astrogalocalcaneal joint. Molded smoothly and evenly over the bony prominences and soft parts, non-padded plaster firmly holds fragments

* From the Department of Surgery of the Louisville City Hospital and the University of Louisville School of Medicine.

in apposition and prevents painful motion. The addition of a protective heel to the cast allows walking, including weight bearing. Absence of pain permits full active functional use of the part without muscle spasm. Continuous active motion is natural physiotherapy and is superior to any artificial and intermittent type, whether active or passive. The ability to use the extremity without pain tends to prevent the disabling limitation of motion so common after immobilization in padded casts. This stiffness is caused, not so much by adhesions within the joint, as by fixation of the muscles, tendons and capsular fascia surrounding the joint. When the extremity enjoys functional use during the period of immobilization these tissues are well nourished, free and supple at the end of the healing period. With each step the muscles and tendons move easily in their sheaths without pain from the firmly fixed bones. Even those muscles whose origins and insertions are so fixed in the cast that they cannot approach each other, undergo contraction and relaxation. The pumping action of the contracting and relaxing musculature takes the place of massage and maintains a normal flow of blood. This to a large degree prevents atrophy and late posttraumatic edema. Even the joint capsules and synovia are moved by the muscle slips inserted into the capsules. Immediately on removal of a non-padded weight bearing cast the previously fixed joint may usually be moved actively through one-half and often through its full nomral range of motion. The normal nutrition and absence of stasis hastens healing of the fracture, as does the mild intermittent pressure on the bone with each step.[6]

Paradoxical as it may seem, pressure and friction sores are less frequent with the non-padded than with the padded casts. The reason for this is not difficult to understand. Plaster accurately molded to the skin equally distributes pressure and stress over the surface of the limb, avoiding concentration of pressure at any one point sufficient to cause necrosis and firm adhesion of the cast to the skin prevents friction. In the padded dressing there is always some motion between the limb and the case. The slight change of position which occurs may compress the padding over the bony prominences to a hard thin layer. The entire pressure of the displacing force, whether it be body weight or muscle pull, is then concentrated on the few small areas where the bony prominences have pressed through the padding. If this pressure is great enough and is continuous anemic necrosis appears. If the pressure is intermittent and tangential friction sores may develop.

Indications for Non-padded Plaster Casts. The non-padded cast may be indicated in all fractures and dislocations of the lower extremity which have been satisfactorily reduced. It is especially useful in conjunction with the walking iron in the prevention and treatment of delayed union. Patients with severe sprains of the knee and ankle may start painless weight bearing immediately. The non-padded cast equally with the padded variety should not be used in the presence of severe soft tissue damage which might result in marked swelling and circulatory disturbance unless the cast is immediately split throughout its entire length. Boehler's method of massaging and pressing away the swelling at the time of fixation somewhat after the fashion of reducing a paraphimosis is useful. In this connection it may well be reiterated that the surest way to prevent and reduce swelling is to reduce the fracture. This fact is not sufficiently appreciated and is sometimes neglected with disastrous results. In modern fracture treatment the fracture is reduced without waiting for the swelling to subside. An equally important item is elevation of the extremity both before and immediately after reduction and fixation, in order to prevent swelling rather than to treat it after it occurs.

The non-padded cast should be used with careful discrimination or not at all in the correction of orthopedic deformities. In the

treatment of fractures the cast merely maintains the parts in their normal state, while in many orthopedic maneuvers the dressing must hold a corrected or overcorrected limb in a position which is distinctly abnormal for the previously deformed member. In such a case, unforseen concentrations of pressure may occur.

General Considerations. The plaster bandages to be used may be prepared in the office or hospital or may be purchased readymade. Adequate directions for their preparation are contained in most standard texts on fractures. They should be made of the best grade of dental plaster, thoroughly rubbed into a good quality crinoline gauze, 28 by 32 mesh. The crinoline should be notched at the edges to prevent raveling. The bandages should be rolled loosely enough to be rapidly saturated when immersed and should be stored in moisture proof containers until ready for use. Bandages five yards long and of two widths, 4 and 6 inches, are adaptable for all dressings of the lower extremity. Within recent years most surgical supply houses have put on the market plaster bandages which are equal or superior in quality, uniformity and long run economy to the usual hospital made bandage. The most satisfactory of these are hard surfaced in such a manner that little plaster is lost in handling, with the result that strong casts may be made with one-half to two-thirds of the number of bandages employed previously.

Four types of casts are used on the lower extremity. (1) the knee length boot for injuries about the distal to the ankle; (2) the upper thigh cast for fractures of the leg; (3) the groin cast with counter pressure pad against the ischial tuberosity which is used for injuries about the knee; (4) the spica for fractures of the femur. These casts are of increasing magnitude and importance and should be approached and mastered in order. It is well for those wishing to train themselves in the use of the non-padded plaster to limit their first few attempts to the reapplication of boot casts on patients with old fractures. This will relieve the operator of the burden of maintaining reduction, will obviate the danger of swelling and will make errors of technique less harmful. When such patients can bear weight without pain or difficulty the surgeon may graduate to the field of acute fractures and more extensive casts. This caution applies just as much to the experienced surgeon accustomed to padded casts as it does to the medical student or interne. Considerable time spent in teaching this method has even led me to believe that previous experience is a hinderance rather than a help in grasping the principles of technique.

The hair is not shaved nor the skin greased before the application of plaster since shaving may cause troublesome skin infections and grease weakens the cast. Uniform incorporation of the hair in the cast gives firm adhesion to the skin and prevents friction between the skin and the cast. Any pull is so evenly distributed among the hairs that it is painless. These hairs die in two or three weeks and separate from the skin without pain when the cast is removed, by which time a new growth of downy hair has appeared. It is well to note here that with the method of functional treatment, early removal of the cast for physiotherapy is neither necessary nor desirable. The sole of the cast should be extended slightly beyond the tips of the toes to prevent flexion contracture and to protect the toes from the weight of the bed clothes. It is extremely important that the dorsum of the foot be covered to the base of the toes although these should be exposed for inspection. If the plaster does not extend to the base of the toes, edema of the dorsum of the foot will occur when the extremity is dependent, just as it occurs distal to an improperly applied elastic bandage. The sharp edge of the cast will then cut into the swollen skin and further trimming will only make the condition worse. Application of pressure to the swollen area by several firmly wrapped layers of adhesive tape will relieve the edema. For the same reason the cast

should not be windowed if the patient is to be ambulatory. Most clean wounds do well if not frequently redressed and we remove excess water, holding both ends of the roll to prevent the escape of plaster. The beginner invariably squeezes the

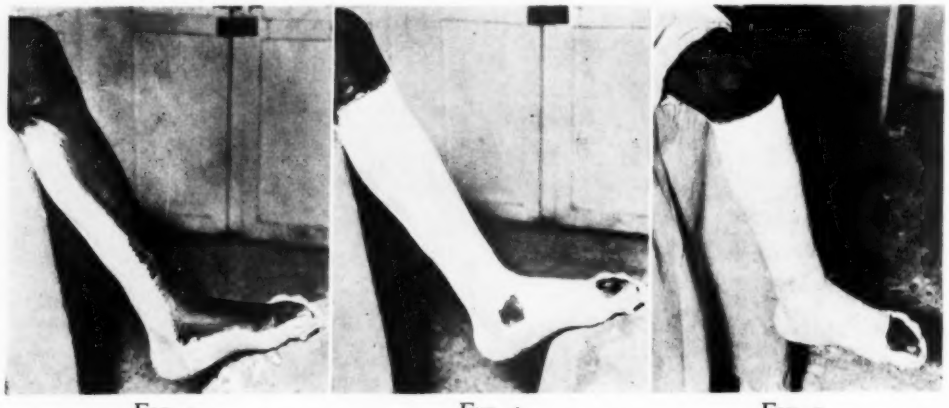

FIG. 1. FIG. 2. FIG. 3.

FIG. 1. Posterior splint applied as first step in boot cast. Note close molding about heel and malleoli and plaster doubled beneath and beyond toes.

FIG. 2. Anterior splint from tibial tubercle to base of toes. Notched over instep to allow smooth fitting.

FIG. 3. Boot cast complete. Note accurate application on dorsum of foot down to base of toes. This prevents edema. 90° flexion at the knee is possible.

routinely leave silk skin sutures in operated or compound fractures until the cast is removed in 6 or 8 weeks. Dressings on wounds beneath the plaster should be as thin as possible, three or four layers of gauze being sufficient and should not be held in place with a circular bandage which will shrink and cause circulatory disturbances after contact with wet plaster. Due to its alkalinity, plaster is bacteriostatic to the usual pathogenic organisms, so infection through a thin dressing need not be feared. If windowing cannot be avoided, enough pressure should be applied over the window between dressings to prevent edema. Longitudinal, anterior and posterior splints are used as the basis of all non-padded casts. They may be molded more smoothly to the contour of the limb than circular turns, and they materially increase the strength of the cast. They also prevent circulatory disturbances by distributing any pressure which might be caused by the tight edge of a circular turn.

If the loose plaster bandage is to be used, it is completely immersed on end in water of about body temperature. As soon as bubbling ceases the bandage is lifted from the water and gently drained to bandages too dry for the non-padded technique; it should be definitely "soppy." To prepare a splint the bandage is unrolled back and forth on a glass, marble or enameled surface to the previously measured correct length until the necessary thickness is obtained, about six or eight layers. Each turn is gently rubbed once with the flat of the hand to smooth it and bind it closely to the previous layer avoiding wrinkles and ridges. The splint is now ready for immediate application and should be soft and wet enough to mold and adhere to the skin of its own accord. Do not make the splint so thick and so dry that it cannot settle itself to the contour of the limb. If the hard surfaced commercial bandage is used the splint is made by unrolling and folding the dry bandage to the desired length and thickness, three or four layers making a sufficiently strong splint. One end of the dry splint is held in each hand and it is run rapidly once through water from end to end. It is now ready for application.

The Boot Cast. This cast is used for lesions about and distal to the ankle. It is ordinarily applied with the foot at right angles to the leg and the knee flexed.

A convenient way to attain this position is to have the patient lie on his abdomen with the leg vertical. If the fracture has been reduced under local anesthesia the conscious patient can easily maintain this position and no assistant is necessary to hold the leg and cause dents in the cast. A previously measured wet splint 6 inches wide is applied to the posterior surface of the leg and foot from the bend of the knee to a point ½ inch distal to the tips of the toes. This splint should be long enough so that 3 or 4 inches of it may be folded back along the sole. The splint is cut on each side of the heel one-third of its width to allow folding over and close molding. The plaster is smoothed onto the skin with the flat of the hand and should be wet enough to adhere. (Fig. 1.) Wrinkles and air spaces beneath the plaster should be smoothened out, especially over the sole and along the Achilles tendon. A similar splint is applied to the anterior surface from the top of the tibial tubercle to the base of the toes. The edges of this are likewise cut over the instep to avoid wrinkles. Special attention is paid to accurate molding over the crest of the tibia and the bony prominences of the ankle. (Fig. 2.) If steel pins have been used in reduction and are to be incorporated in the cast, the splints are cut to closely surround them. Circular turns are now added from the base of the toes to the top of the splints. These should be rolled on smoothly and evenly and not drawn snug or tight. The bandage should not be reversed and should be applied in an evenly ascending spiral with an occasional smooth fold. Each layer is rubbed into the succeeding one with the flat of the hand. If pins are to be incorporated, loops are taken about them on each side of the limb so that they are firmly fixed in the plaster. If support of the limb is necessary during the application of the cast, it should be applied by the palm with extended fingers to avoid circumscribed dents in the plaster. The position of the ankle joint must not be changed during the application or setting of the cast or wrinkles will occur. Two or two and a half rolls of 6 inch hard surfaced plaster are sufficient for a boot cast. If pins have been used the sharp ends are covered with corks held by additional plaster. Any necessary trimming of the cast is done as soon as the plaster has set, usually about fifteen minutes. At the upper

Fig. 4. Strap iron, 24 inches by ¾ inches by ⅛ inch, bent to correct shape. Plaster on arms of iron to aid fixation.

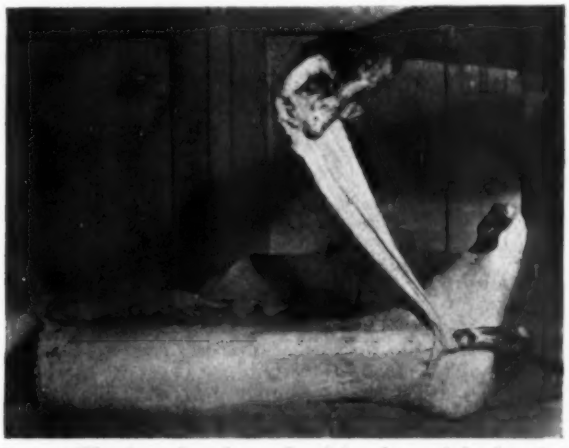

Fig. 5. The iron has been fixed in the weight bearing line of the leg with scant two finger's distance from iron to sole. Most of plaster has been applied at upper end of iron to resist upward thrust. Loops are taken about iron to assist fixation.

end of the cast the plaster should reach to the tibial tubercle anteriorly but should be trimmed behind to allow right angle

FIG. 6. FIG. 7.

FIG. 6. Cast for fracture of ankle after 6 weeks of ambulatory treatment. Worn plaster on dorsum of foot has been repaired with adhesive.

FIG. 7. Same cast as Figure 6 seen from behind.

flexion of the knee. (Fig. 3.) If the cast is cut too low the soft tissues of the calf will bulge over and be irritated by the edge of the plaster. The patient is transported to bed with the cast on a soft pillow to prevent flattening over the calf and heel from pressure. The extremity is elevated 8 to 10 inches above the bed beneath an electric light bake for twenty-four to forty-eight hours for thorough drying of the cast and to prevent swelling in fresh fractures.

The Walking Iron. The walking iron heel which we use is a 24 inch length of ordinary $\frac{1}{8} \times \frac{3}{4}$ inch strap iron which may be obtained from any machinist or blacksmith supply house. The crosspieces used by Boehler are unnecessary and increase the expense. The iron is usually not applied for twenty-four hours. This allows the cast to dry and prevents pressure from the iron. The iron is bent by hand or wrenches into a flat bottomed "U" slightly wider than the malleoli, accurate modeling not being necessary. The arms of the "U" are covered with one layer of wet plaster to aid cohesion. (Fig. 4.) The iron is fitted with the arms over the malleoli and accurately placed in the weight bearing

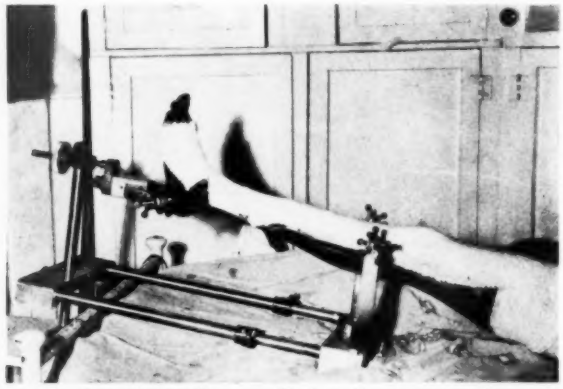

FIG. 8. Anterior splint applied as first stage of cast for compound comminuted fracture of tibia and fibula. Extremity is in skeletal reduction and fixation apparatus. Note smooth molding to skin. A circular layer of flannel at upper end of cast prevents friction.

axis of the leg. (Fig. 5.) If the iron is placed anterior to the weight bearing axis, the knee tends to hyperextend when the patient attempts to walk. When the iron is too far posterior the patient attempts to flex the knee on weight bearing and the toe of the cast rests on the floor. Either of these positions will cause pain. A scant two finger breadth is allowed between the sole and the iron. One-half of a 6 inch plaster bandage is sufficient for fixing the walking iron. A circular turn about the ankle is followed by loops or half-hitches about the iron on each side to prevent anterior or posterior motion. Most of the plaster is used for circular turns about the upper end of the iron to firmly bind it to the cast and take up the vertical strain of weight bearing. Walking is allowed twenty-four hours after application of the iron. (Fig. 6 and 7.) A 3 or 4 inch length of old garden hose slipped over the iron makes a good non-skid cushion and prevents the iron from scratching floors.

Thigh Length Casts. For injuries between the ankle and the knee the cast must be extended to the upper third of the thigh. A single layer of soft flannel about 6 inches wide should encircle the thigh at the upper edge of the cast to prevent friction from

the sharp plaster. The laxity of the fleshy thigh makes this necessary since the upper portion of the cast cannot be snugly molded

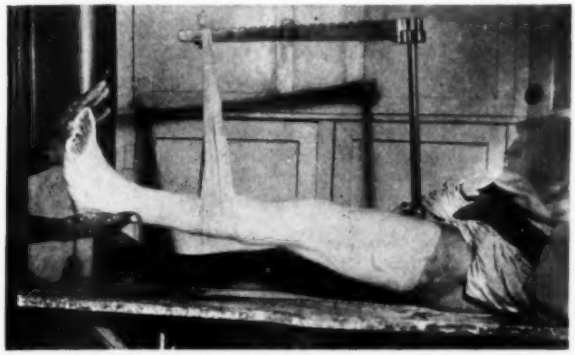

Fig. 9. Both splints applied for simple transverse fracture in which skeletal reduction and fixation was unnecessary. Muslin sling beneath fracture site supports weight of leg and makes accurate alinement much easier. "Anyone can reduce a fracture of the leg, but few can maintain corrected position while the case is being applied." Any overhead object to which a bandage may be tied may be used in place of a Hawley table.

to the bony prominences as at the knee. All casts fixing the knee must be applied with this joint extended (not hyperextended) if the patient is to be made ambulatory. (Fig. 8.) Attempts to bear weight with the knee partly flexed cause friction, pain and pressure over the patella. The application of this cast is simplified by suspending the extremity from an overhead bar by not more than two slings of 6 inch unbleached muslin bandage. (Fig. 9.) One sling should be placed at the fracture site in order to maintain anterior bowing, the second just above the knee. This relieves the assistant of the weight of the leg and allows him to concentrate on maintaining traction and alinement.[7] Special care should be taken to see that there are no wrinkles or folds in those parts of the sling in contact with the skin. Anterior and posterior splints are applied from the middle of the flannel bandage downward to the same limits as for a boot cast. The edges of the anterior splint are cut opposite the patella and the sling to allow for accurate molding. The plaster must fit evenly and smoothly over the patella and the heads of the tibia and fibula. Air pockets must be smoothened out around and between the ham-string tendons. Short lateral splints may be molded

Fig. 10. Completed cast with iron heel for compound fracture of tibia and fibula. Note limits of cast, pin ends protected by corks and plaster and position of walking iron.

about the knee for additional strength. The distal portion of the cast is constructed as before and the circular turns continued to the top of the splints. These turns surround the slings in figure of eight fashion anteriorly and posteriorly. The proximal turns of plaster should be sufficiently snug to hold firmly the relatively flaccid soft tissues of the thigh. The danger of circulatory disturbance from tight application of plaster is not nearly so great as in the leg and foot because of the fleshiness of the thigh. As soon as the plaster has set the slings are cut on both sides close to the cast and their ends loosened from the plaster to relieve tension. Another layer of plaster is applied over these areas to finish the cast. A good non-

padded cast of this type sufficiently strong for weight bearing may be made from not more than four 6 inch bandages. (Fig. 10.)

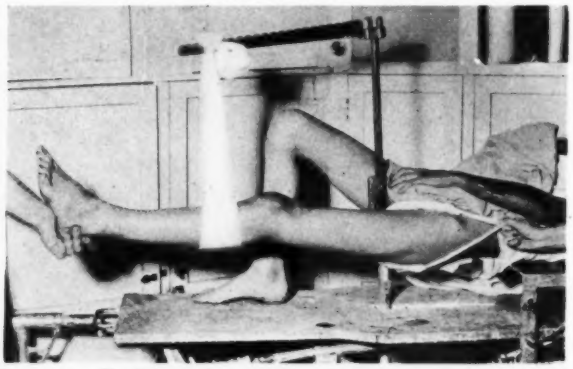

FIG. 11. Position for application of cast for simple transverse fracture upper end of tibia and fibula. The perineal roll is shown pulled firmly against the tuberosity of the ischium and the origin of the adductors by an assistant.

Occasionally the thigh portion of this type of cast is found to be loose after a few weeks. This will allow slight motion at the knee and cause pain from friction over the patella. Relief may be obtained by removing a wedge shaped section from the posterior aspect of the cast down to the knee and reapproximating the edges with plaster. This maintains extension of the knee and prevents motion. If the wedge is removed from the anterior aspect of the cast the knee becomes slightly flexed and walking is impossible.

The Groin Cast. The groin (Thomas caliper type) cast is used for fractures involving the upper end of the tibia, the patella and for the convalescent support of some fractures of the shaft of the femur. It includes at its upper end a padded roll similar in size, consistency and function to the ring of a Thomas splint or walking caliper brace. This roll, resting against the tuberosity of the ischium and the origin of the adductors, transfers some of the stress of weight bearing to the pelvis. The pad is made by rolling tightly an 8 × 10 inch piece of silence cloth or thin felt about the center of a three foot length of muslin bandage. This roll is completely covered by a spiral of one inch adhesive tape which compresses it to the size and firmness of a Thomas splint roll. It is applied with its center over the tuberosity of the ischium, the posterior end lying

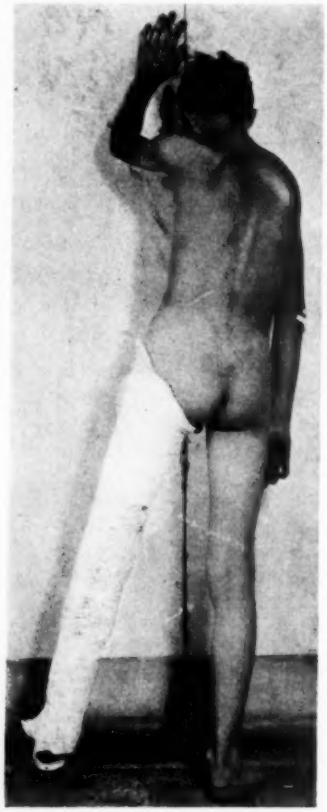

FIG. 12. Completed groin cast. The shelf of plaster holding the perineal roll in place is well shown. The distance from sole to heel is too great. This is not so obvious when the shoe is worn on the other foot.

in the gluteal fold and the anterior end crossing the hip joint. By pulling firmly outward and upward on the ends of the bandage, the pad is snugly fitted beneath the tuberosity and the origin of the adductors. (Fig. 11.) Anterior and posterior splints are applied from the pad downward. The upper circular turns incorporate the pad and are snugly molded on the medial side to form a shelf like structure which holds the roll firmly against the ischium. Five 6 inch hard surfaced bandages are sufficient for this type of cast. (Fig. 12.)

The Hip Spica. The spica is used for all fractures of the femur. This cast is most easily applied with the patient on the Hawley table with traction supplied by a Collin's hitch about the ankle and support of the knee by a muslin sling.

Since the skin of the thoracic and abdominal walls moves with respiration it must be protected from friction, as must the bony prominences of the pelvis, which cannot be completely immobilized. Accordingly, the anterior superior spines and the sacrum are covered by patches of silence cloth which are held in place by a stockinette or a circular layer of flannel bandage extending from the xiphoid to the trochanter. This bandage should be wrapped tightly about the pelvis in figure of eight fashion to compress the lax buttocks. A padded roll is snugged to the tuberosity of the ischium as for the groin casts. One layer of flannel is applied to the leg just above the ankle hitch. (Fig. 13.) Circular plaster bandages are applied snugly to the trunk and pelvis and molded about the crests and spines of the pelvis. (Fig. 14.) Anterior and posterior splints are molded to the skin from the lower third of the leg up over the pelvic portion of the cast. The region of the hip is strengthened by four or five spica-wise splints which also support the ischial pad. The whole is covered with circular plaster. (Fig. 15.) While the plaster is setting an assistant should apply constant pressure on both sides of the pelvis to mold the plaster to the crests of the ilia and the hollows between the crests and the trochanters. When the plaster has set firmly twenty or thirty minutes, the leg is supported and the Collin's hitch removed. Anterior and posterior splints are placed from the toes to overlap the previous plaster about 6 inches and are covered with circular turns as in the other casts. Trimming of the cast is done to uncover the upper abdomen and allow free motion of the uninjured thigh. (Fig. 16.) The patient is turned on his abdomen and trimming of the posterior part of the cast carried out. It should be cut to the top of the cleft of the buttocks and about 2 inches to the side along the cleft to allow use of the bed pan. (Fig. 17.) If trimmed too far over the buttock, bulging and irritation from the edge of the cast will occur.

Unless properly tended in the first forty-eight hours these casts may crack at the hip. Breaking at the hip is almost always due to adduction force. Therefore, in turning these patients they should be rolled toward the well side with adequate support of the casted limb. Better yet, if enough help is available, turning is accomplished by lifting the patient straight up, turning him in the air and laying him down. After forty-eight hours a properly constructed cast should not crack. For an adult of average size twelve to fourteen hard surfaced 6 inch bandages are sufficient to make a spica which will stand constant weight bearing. Such a cast will weigh about twelve pounds.

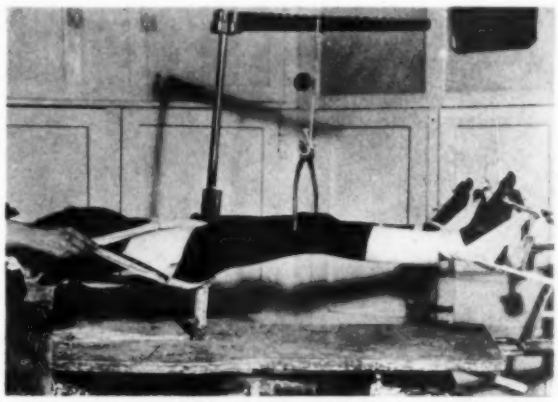

Fig. 13. Patient with fracture of the shaft of the femur in traction on the Hawley table. Pins are inserted in both fragments for manipulation and skeletal fixation. Note perineal pad and silence cloth over spines and crests of pelvis and over vertebra. Flannel bandage about leg above Collin's hitch.

Circulatory Disturbances. In almost all cases proper elevation of the injured extremity before and after reduction will prevent dangerous circulatory disturbance even in fresh fractures. Severe soft tissue injury or neglect of elevation may cause excessive pressure within the cast at the site of fracture. A vicious circle is then established. Swelling causes pressure which obstructs the venous and lymphatic return flow thus leading to more swelling. The only remedy is *immediate splitting of the cast throughout its entire length.* Partial splitting distal to the fracture is useless. The signs of pressure in the order of their appearance

in the toes are: (1) edema, (2) cyanosis, (3) loss of sensation and (4) impaired motion. Edema and cyanosis may be

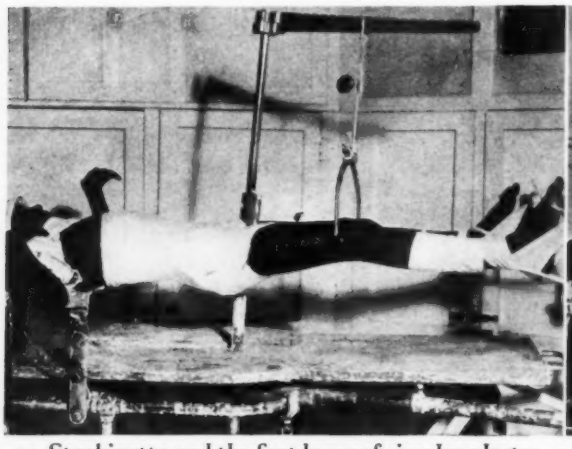

FIG. 14. Stockinette and the first layer of circular plaster have been applied snugly about the trunk and pelvis incorporating the upper pin.

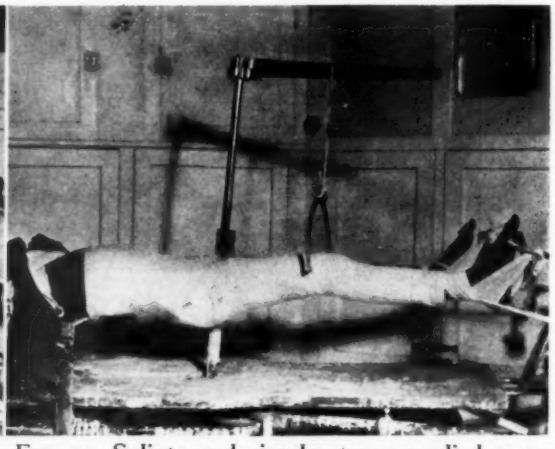

FIG. 15. Splints and circular turns applied to trunk, pelvis, thigh and leg down to middle of flannel bandage. All three pins are closely incorporated in plaster. This portion is allowed to set (20 to 30 minutes) before traction is released and distal portion of cast completed.

treated by elevation and careful observation. Inability to wiggle the toes and loss of sensation, however, are immediate

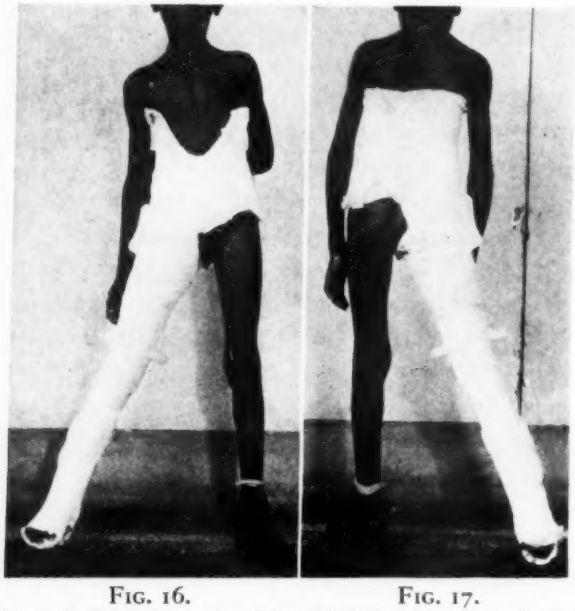

FIG. 16. FIG. 17.

FIG. 16. Complete spica. Note high fixation of trunk and trimming for abdominal movement and flexion of uninjured thigh. Covered pin ends are clearly shown.

FIG. 17. Posterior view of the same cast. Note shelf for perineal pad and proper trimming about buttocks.

indications for splitting of the cast, as is excessive pain at the site of the fracture. Schneck[5] says, and quite truly, "As long as localization of the part touched is possible, the circulation can be considered adequate." If circumstances are such that the patient with a fresh fracture cannot be observed every six hours for the first day, the cast whether padded or not, should be split in anticipation of trouble. It should be split along that side of the extremity which will give the greatest relief to circulation with the least danger of displacement of the fracture. In the leg this is laterally rather than over the poorly covered tibia. The pressure of the swelling itself usually spreads the cast open the necessary amount. Occasionally it must be spread further and it is especially necessary to be sure that every thread of the circular bandage has been divided. When the swelling has subsided, the cast may be reapproximated with adhesive tape or another layer of circular plaster.

Removal of the Cast. Non-padded casts should not be removed before three weeks. By the end of this time the incorporated hairs have died and will pull painlessly from the skin. Instruments used for removing or splitting the cast are the parrot beak cast knife, cast cutters and spreaders. The walking iron is usually removed first. Then cutters are used, running down the lateral side of the cast and behind the lateral malleolus, avoiding the bony prominences.

In using the cutters it is best to take small bites with the cutter blades at a 45° angle to the cast. The blades merely grip the cast rather than shear it. Raising the handles with a can opener motion completes the cut. The knife is used in difficult angles or over bony prominences. The parrot beak tip is inserted beneath the cast with the back of the blade against the skin, cutting outward. If these directions are followed there will be no injury to the skin. Occasionally transverse cuts must be made before the cast can be spread sufficiently to remove it from the limb.

CONCLUSIONS

1. The non-padded plaster cast supplemented by skeletal fixation when necessary is the most satisfactory dressing for the majority of fractures of the lower extremity.

2. Incomparably secure fixation is provided and the patient is ambulatory or at least mobile.

3. Active use and weight bearing lessen the temporary and permanent disability.

4. Four types of casts are useful for injuries of the lower extremities, the knee length boot, the thigh cast, the groin cast and the spica.

5. Directions for the proper application of these casts are given.

6. Circulatory disturbances may be avoided with proper care.

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INFECTIONS OF PAROTID GLAND*

FURTHER STUDIES ON ETIOLOGY AND TREATMENT; SIALOGRAMS OF NORMAL AND ABNORMAL GLANDS AND DUCTS INCLUDING TUMORS

WILLIAM H. HOBBS, M.D. AND HYMAN SNEIERSON, M.D.

Attending Surgeon, Binghamton City Hospital

Associate Attending Surgeon, Binghamton City Hospital

BINGHAMTON, N. Y.

SINCE the publication in 1935 of our report on infections of the parotid gland, there have been many more contributions to the literature. Great strides have also been made in the use of iodized oil injections for the visualization of tumors of the parotid. We have, therefore, felt encouraged to present further reports of our work along this line as well as a review of current literature.

ETIOLOGY

There is still a difference of opinion as to the method of infection, the concensus gradually swinging to the ascending theory as against the hematogenous. The most authentic report which we found was by Kamniker.[11] In acute parotitis he obtained consistently cultures of staphylococci from Stenson's Duct. The striking case reports were those of a patient with typhoid fever and a positive blood culture and another with pneumonia. In each case culture showed staphylococci predominating without the organism causing the main condition being present. Leithauser and Cantor[13] also found staphylococci in cultures from the duct and from the incised gland in almost all cases where a culture was obtained. Talbot[20] reports staphylococcus infection of the parotid in a case of pneumonia.

In our first paper we agreed with these general views. We, however, felt that hematogenous infection does occur and cited one case in our series of 16 in which, in our opinion this had happened. (Case v.[10]) We postulated the theory that there was a difference in the appearance of the orifice of the duct between cases of ascending and of hematogenous infection. In the ascending type, the orifice would be red, pouting and swolling, with pus oozing from it or be expressed by pressure on the gland or duct. In the hematogenous type, the orifice would be normal or only slightly reddened, would not pout or be swollen, and pressure would cause the appearance of normal saliva. This statement has apparently been overlooked by later writers. It is to be expected and yet rather striking that the duct orifice in mumps is normal in appearance.

At the time of writing we were unaware of the classical experiments carried out by Berndt, Buck and Buxton[4] under the

MICROSCOPIC APPEARANCE OF INFECTED PAROTID GLANDS

Ductogenous Parotitis	*Hematogenous Parotitis*
1. Distention of ducts with purulent exudate.	1. Purulent exudate in ducts less marked. Ducts not distended.
2. Large ducts involved most extensively, small radicals least.	2. Large ducts relatively unchanged. Small radicals chiefly involved.
3. Extensive destruction of duct epithelium.	3. Epithelial lining of ducts intact, or occasionally hyperplastic.
4. Periductal reaction most prominent where duct wall is broken.	4. Periductal reaction more uniform in distribution.
5. Periductal cell reaction chiefly neutrophibic.	5. Periductal cell reaction chiefly monoculear.
6. No changes in blood vessels.	6. Swelling and hyperplasia of artiolar endothelium with occasional beginning annular thrombus formation.
If our original hypothesis were correct the following statements should also be true:	
7. Duct orifice swollen, red, pus present or able to be milked from duct.	7. Duct orifice normal in appearance or slightly reddened. Secretion normal.

* From the Department of Surgery, Binghamton City Hospital.

supervision of Custer.[6] The authors have definitely disproved the older theory of Rost that the pathological picture in acute parotitis is the same in both types of infection. In their experience also, ascending infection in the dog was easier to produce than hematogenous, a point which is of great interest. Seven of 10 were infected of the ascending type group while only 3 of 15 showed infection when the bacteria were injected into the parotid artery. A résumé of their findings is in order at this time.

In the article cited no mention was made of the appearance of the duct orifice during the experiment. Upon inquiry, Dr. R. P. Custer sent the following reply, of September 13, 1935, which we report verbatim with his permission.

In the experimental phase of the parotid work we observed the orifice of Stenson's Duct. The few glands infected by the blood stream route were not accompanied by an abnormal appearance. Those infected via the duct showed definite inflammatory changes of the orifice, i.e., swelling, redness and suppuration. These changes, however, may not be comparable to those of spontaneous human cases because it was necessary either to plug or ligate the duct to effect a take.

Referring again to Kamniker's[11] work, we note that a decline in the general condition and resistance to infection are the most important factors in ascending infection. Custer[6] produced infection in the healthy dog by plugging the orifice or by ligature. That the duct is plugged in the human cases by increase in viscosity of

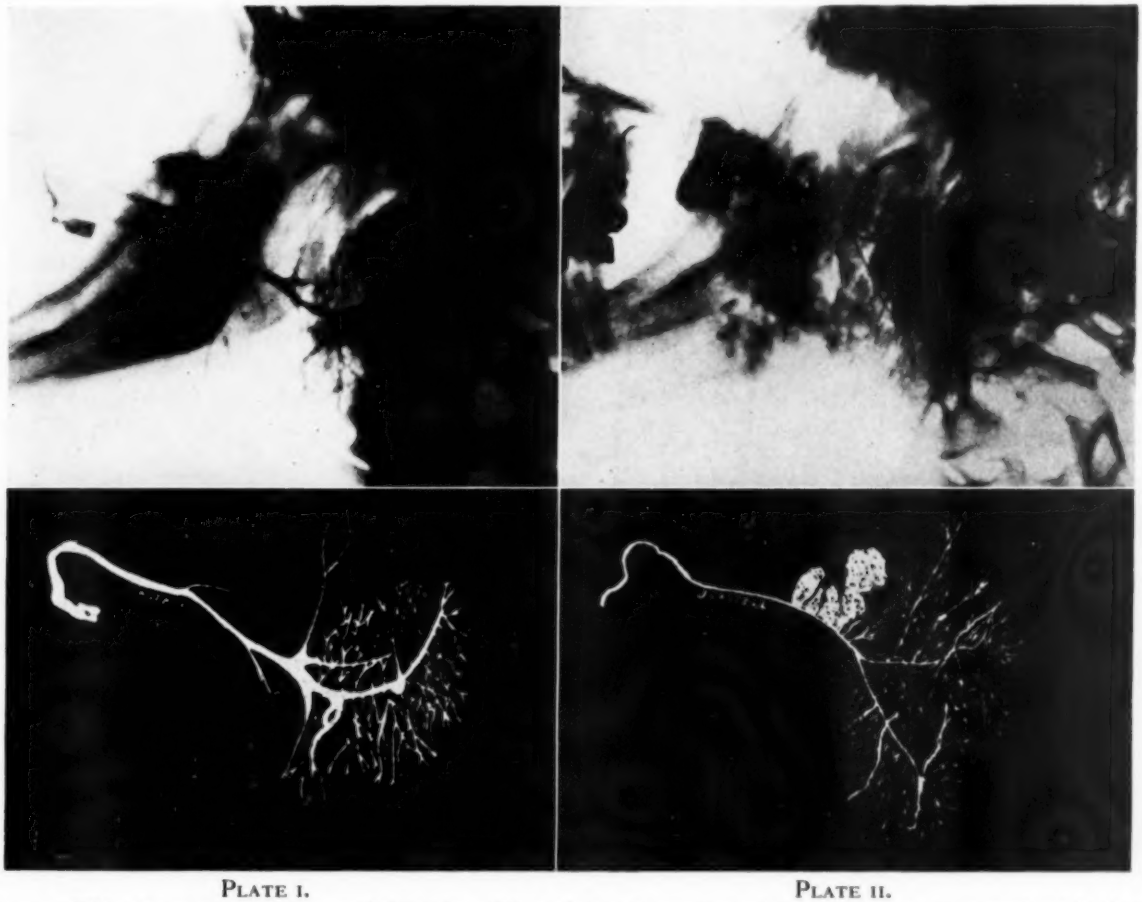


Plate I. Plate II.

Plate I. This shows normal duct and ductules with peripheral structure clear cut. The accessory gland is shown by fine ductules.

Plate II. This shows normal duct and ductules with peripheral detail well defined. The mass which presents in the area where accessory gland should be is due to imposition of injected pathological opposite gland which was not empty when this plate was taken.

saliva in ducts which are atonic and in tissues which have lost their power to repel bacterial invasion seems logical.

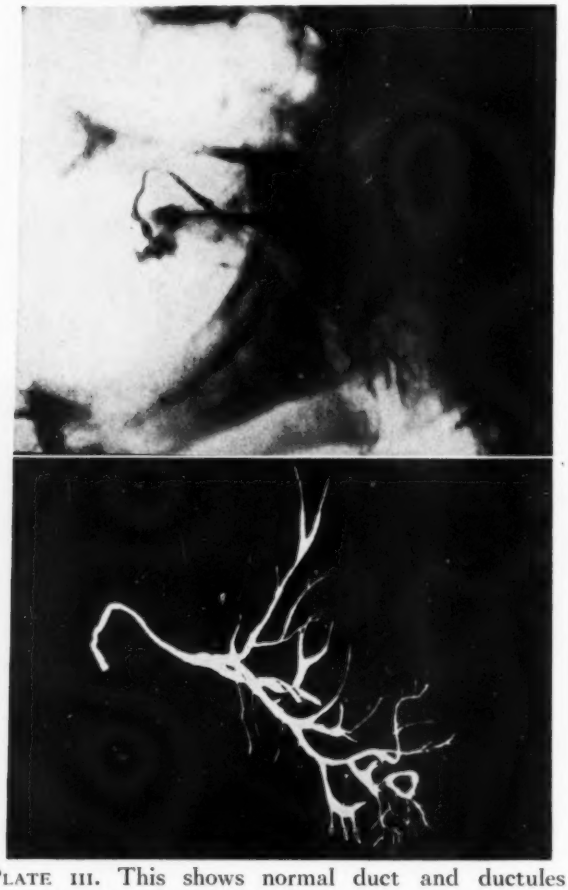


PLATE III. This shows normal duct and ductules emphasizing the variability in caliber when injected. They are clear cut however and differ radically from the pathological ones to be shown later in the study. The accessory gland is well demonstrated by the vertical duct. The peripheral detail is not as well brought out as in Plates I and II.

The appearance of thick, tenacious, stringy saliva which is cleared from the mouth with difficulty is often seen in debilitated patients. A rather far fetched but interesting analogy is pulmonary atalectasis due to blocking of a bronchus by secretion when the cough reflex is impaired.

Talbot[20] in summing up the reasons for believing infection is usually of the ascending type states "most cases show clear evidence of infection of Stenson's Duct, pus being present at its orifice. Were the infection of hematogenous origin there is no reason to suppose that pus would appear in the duct at an early stage."

The predominance of ascending infection as a cause of parotitis is theoretically as well as practically evident. Lowering of local resistance, increased viscosity of saliva, etc., occur where parotitis is most often seen.[15]

The frequent presence of bacteria in the blood (bacteremia) is an accepted fact and under ordinary conditions is of little practical value. Menken[14] states that dye injected intravenously is rapidly accumulated in areas of previously prepared inflammation. Bacteria act in the same way, i.e., osteomyelitis following trauma. Accordingly, hematogenous parotitis would occur ordinarily only if the gland were previously affected in some way. It would have been instructive to see if more takes occurred when the glands were previously bruised. The possibility that rough handling of the gland by the anesthetist may play a part, as once suggested and later discarded, is therefore tenable. The apparent rarity of hematogenous infection is also understandable, and the result obtained by Custer[6] to be expected. In our opinion however, more cases of hematogenous infections of the parotid will be reported when they are examined and classified as we suggest.

TREATMENT

The treatment of acute cases cited by us previously, as hot or cold applications, massage of the gland, heliotherapy, *x*-ray and radium packs, as well as dilatation of Stenson's duct are still in vogue. The use of the radium pack as advocated by Rankin and Palmer[15] is at present the most used method when available. Coller and Yglesias of Ann Arbor use dilatation of the duct coincidently with the radium pack. The only new method of treatment which we found advocated was the use of Lugol's solution in large amounts.[13] The general doctrine that radical operation is indicated if no abatement of symptoms occurs in about three days is still widely accepted.

In reference to our treatment of acute cases there seems to be a misunderstanding. We used mercurochrome initially, but

stated that we had discarded this later in our studies. Apparently our later statements were overlooked. (Christopher—Minor Surgery.) We therefore feel that a description of our present technique may be of interest.

We omit injection of mercurochrome or any other irritating substances in the care of acute cases of the ascending type. We dilate carefully and then irrigate with normal saline. Fluids are forced and the patient is encouraged to open and close the mouth as much as possible, thereby causing a mild massage of the gland. In the future we also intended to use Lugol's solution at the same time. Theoretically this follows the lines used in pyelitis, i.e., lavage of the pelvis plus antiseptics by mouth. Use of bacterophage might be of value as an irrigating solution. The use of radium packs impresses us as being of the same value as their use in the treatment of acute infections elsewhere.

Perusal of the case reports cited in the literature was illuminating. When cultures were positive and the appearance of the orifice was noted, it was red, pouting and pus could be expressed. Since dilata-

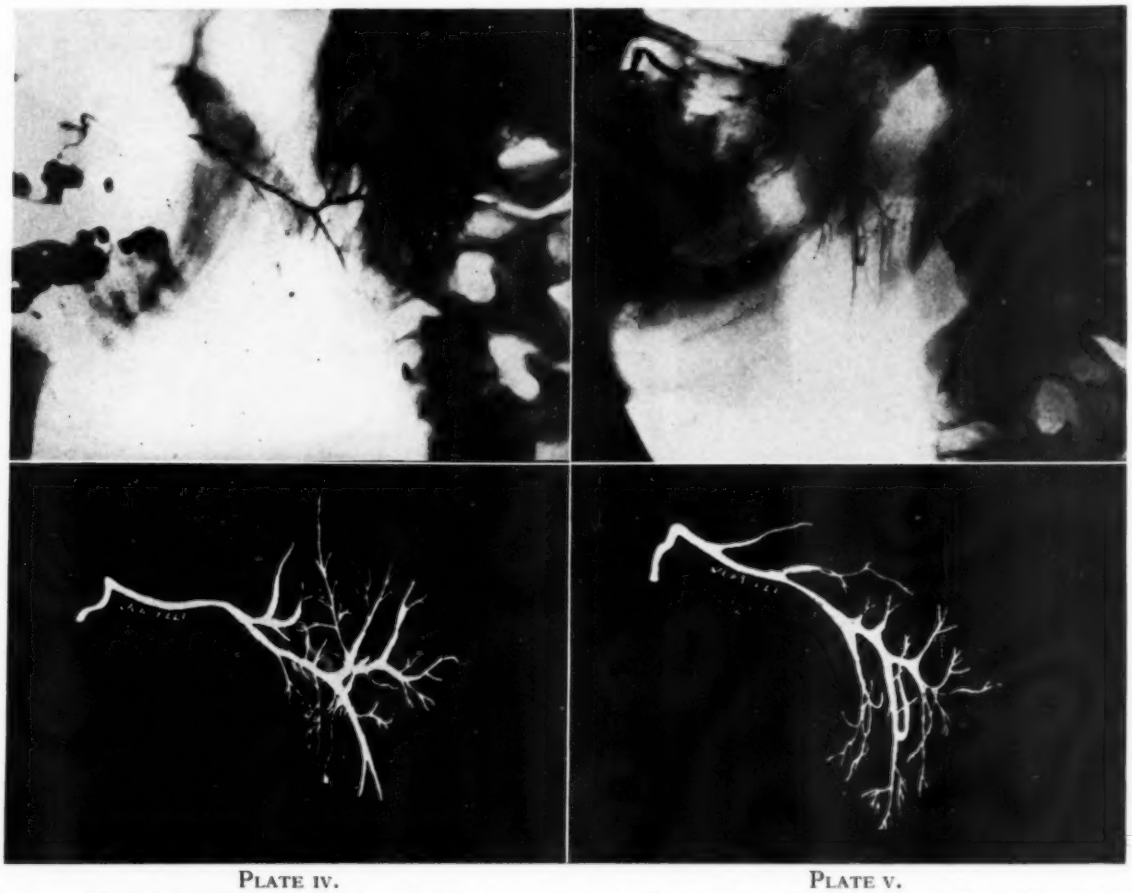


Plate IV. Plate V.

Plate IV. This shows clear-cut ducts and ductules, accessory gland and moderately extended peripheral detail. This patient had an attack of mumps in 1931, which was ushered in by pain and swelling of the right testicle. About four hours later there was swelling of the right parotid. He was hospitalized in one of the large Isolation Hospitals in Boston, Mass., where after intensive study a diagnosis of epidemic parotitis (mumps) was made. Convalescence was uneventful aside from atrophy of the testicle. It is evident that despite the severity of the infection the parotid gland recovered completely.

Plate V. This shows normal ducts and ductules, accessory gland and moderate peripheral detail. This patient had a bilateral parotitis with left orchitis and resulting atrophy of the left testicle. Like Plate IV the sialogram appears normal in every detail.

Comment. The plates shown above vary in appearance as would be expected. They however are considered normal inasmuch as the ducts and ductules are clear cut. The details of the periphery vary with the individual and also with the pressure of the injection. We do not feel that complete peripheral injection must be shown in order to make a diagnosis of a normal gland.

tion was not done in any of the cases cited, the fairly frequent occurrence of suppuration was to be expected.[13,20] Since we have been doing this work, no breaking down has occurred when the dilatation and treatment as mentioned was consistently followed, even in fatal cases.

In the hematogenous type, the use of *x*-ray and radium packs would be the accepted procedure when possible. In our case, the use of cold and hot applications was accompanied by a cure. The use of Lugol's solution also may be of value. Dilatation is contraindicated.

Treatment of chronic infections was little mentioned in literature. Simon[16] uses "bougienage" or dilatation of the duct as we do. The use of radium packs would seem to us of questionable value as the pathology is due to inadequate drainage plus a low grade infection. The sialograms support this point. Lugol's solution by mouth at the same time is worth trying. In the treatment of chronic recurring parotitis, treatment is directed to obtaining free flow of saliva and stimulating the gland and ducts by infrequent gentle dilatation. Frequent rough treatments or the use of irritating solutions may aggravate the condition. Lipiodal seems to gently irritate the ducts in a favorable way.

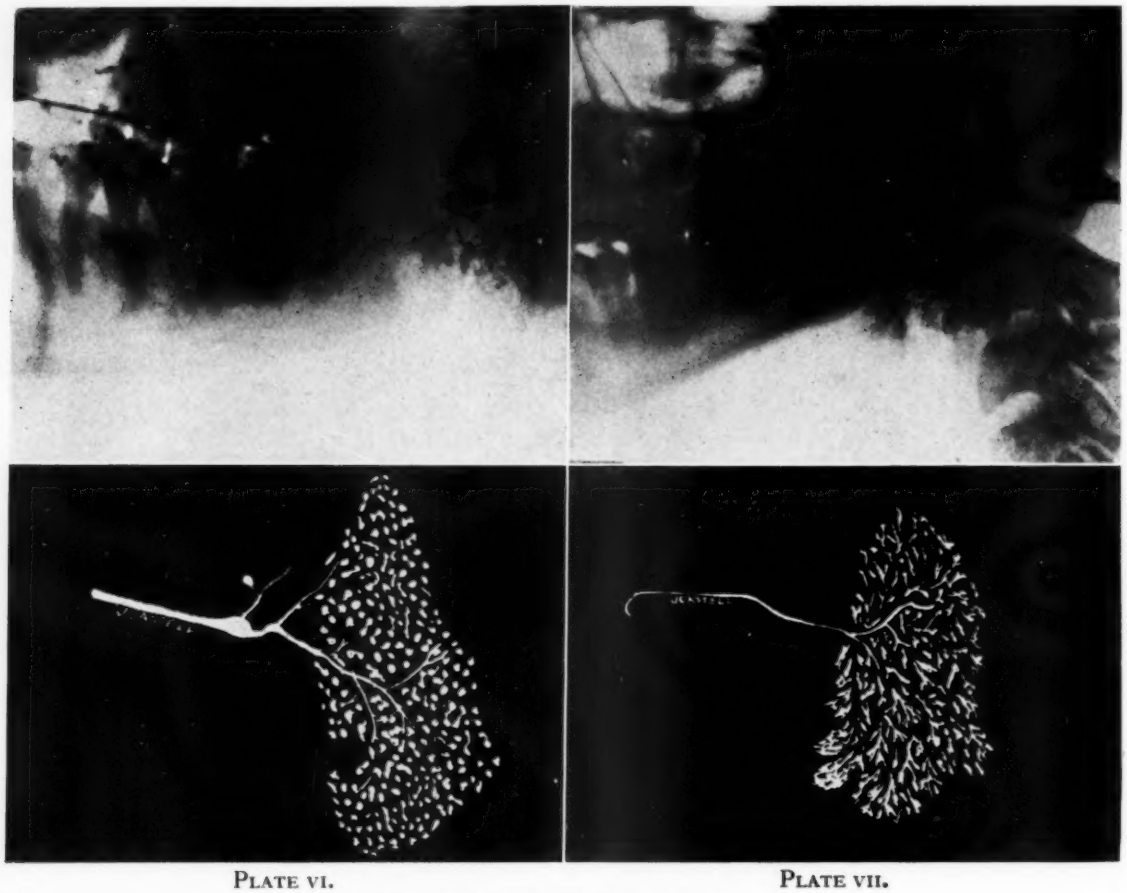


PLATE VI. PLATE VII.

SIALOGRAMS OF NORMAL GLANDS

(*Shotlike Type*)

PLATE VI. Case V. This is a sialogram of normal parotid gland. This patient had mumps in childhood, but has had no other trouble with the parotid gland shown. It is noted that the ductules end in irregular small dilatations. These can be noted only on close examination of the sialogram. In our previous report[10] we called attention to this type and referred to it as "shotlike."

PLATE VII. This is a normal gland in a patient who has had no trouble in this area. It is noted that there is some irregularity in the ducts and that the periphery shows a slightly more pronounced condition of terminal dilatation.

COMMENT. These sialograms are of parotids which have had no history of previous clinical trouble and therefore in the light of our present knowledge and despite their bizarre appearance we must consider them normal.

CASE REPORTS

Case I. Miss R., age nineteen years was seen April 6, 1932. This patient developed an acute parotitis on the third day following an appendectomy for acute catarrhal appendicitis. The inflammation was ushered in with a temperature of 103°. The left parotid was swollen and tender with pouting redness of the duct orifice. Pus was milked from the duct. This was dilated and irrigated with saline solution. Two days later the patient was free from fever. April 11, 1932 gland was normal in appearance.

Case II. Mr. E., age twenty-two years was seen June 5, 1934. Three days previously the patient had had a tooth extracted. Two days later there was sudden pain in the right parotid and temperature was 102°. The gland was swollen and tender, the orifice of the right duct was red and pouting and pus could be expressed. The duct was dilated and irrigated with saline for three days. The temperature dropped to 99° and the swelling subsided gradually. On June 15, 1934 there was complete subsidence of all signs and symptoms.

Case III. Miss E., age twenty years was seen May 9, 1935. The patient was operated for acute appendicitis April 29, 1935. Five days later the temperature suddenly arose to 104.2° with pain and marked swelling of the right parotid. The swelling was so intense that the skin was tense and shiny. The duct was red and pouting and after dilatation pus drained freely. May 12, 1935 her temperature was 98.3° and the swelling had subsided entirely.

Case IV. Mr. F. B., age sixty-two years was seen August 9, 1935. He was admitted to the Binghamton City Hospital in a critical condition with a gangrene of the little toe. The admission temperature was 104.3°, pulse 120, respirations 24. There was sugar in the urine and many granular casts. The patient was treated medically with some improvement. Amputation at the lower third of the right thigh under spinal anesthesia was done on August 14. The patient's condition gradually failed, his temperature ranging between 100° to 102°. August 21, 1935, there was pain and swelling of the left parotid which gradually became more marked. There was no change in the general condition, and no rise in temperature at the onset of the infection. The duct was dilated and irrigated with mercurochrome August 24, 1935. He also had a severe cystitis and right conjunctivitis. The temperature remained about the same until his death August 26, 1935.

SIALOGRAMS OF INFECTED PAROTIDS

(Shotlike Type)

Plate VIII. Case VIII. (Fig. 10 Original Report.)[10] This plate represents the appearance of a parotid three weeks after an attack diagnosed "mumps." Externally there was a faint swelling with tenderness to palpation. The duct orifice was normal.

The duct is essentially normal with shotlike appearance of periphery. This cannot be differentiated from normal Plates VI and VII.

Case V. Miss A. M., age eighteen years was seen July 6, 1935. The patient had a history of pelvic inflammation of three weeks duration. She had been treated with diathermy without relief. She showed a "frozen" pelvis with a mass filling the entire lower quadrant, palpable through the abdomen. She received several Elliott treatments without much relief, the last being July 19, 1935. This was given for thirty minutes at 115°. July 20, the patient complained of sudden pain in the left parotid region. Temperature was elevated slightly above the previous level. There was no chill. Orifice of Stenson's duct was slightly reddened but not enlarged or pouting and clear saliva

was expressed. She was given an iodine mouth wash and magnesium sulphate cold compresses applied. Because of pain and inability to open her mouth, she was not able to eat. A continuous clysis was given and sedatives were administered as necessary. Temperature gradually fell to 100° by July 23, and was normal by July 28. At this time the gland was not swollen, but tender on pressure. A lipiodal injection of the infected gland was made August 4, 1935 and of the opposite side August 5.

During the acute stage of the pelvis inflammation which coincided with the inflammation of the parotid gland, the patient had intense abdominal pain, much more than is usual in a pelvic inflammation. The Elliott treatments at first seemed to relieve this condition, but the last one made it definitely worse. There is a question in our mind whether the last treatment in some way liberated emboli, one or more of which ended in the parotid gland. However, she had no signs or symptoms of emboli elsewhere.

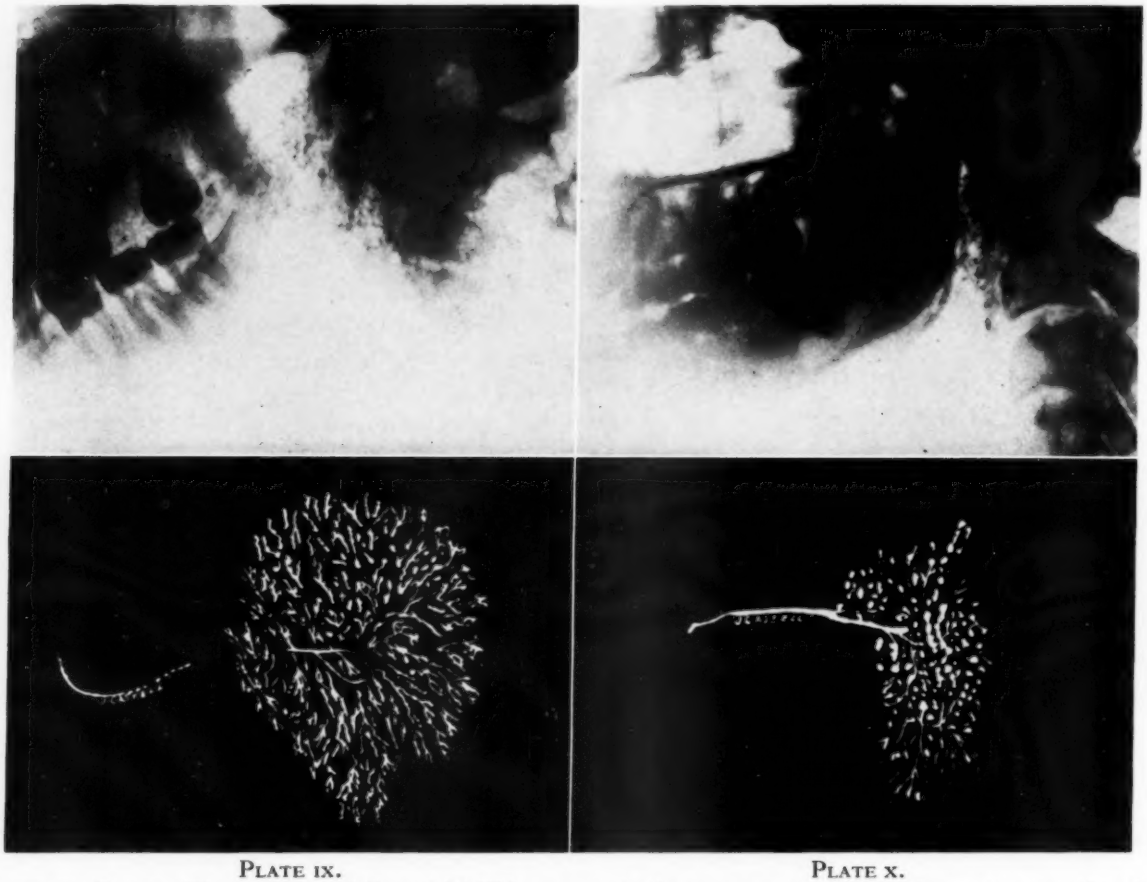


PLATE IX. PLATE X.

PLATE IX. Case X. (Fig. 12 Original Report.)[10] This represents the appearance of a gland seen two months after an infection. At this time there was a marked tender swelling externally with an injected pouting duct. The secretion was thick and contained white flakes. Condition cleared up on dilatation and lavage.

The sialogram shows the shotlike appearance, but to a less marked degree. The duct seems normal.

PLATE X. This is a sialogram of Case V diagnosed "Hematogenous Infection." (Compare this with Plate VI which is the normal gland of the same patient.)

The duct is normal in appearance. The ductules show the pocketing seen in the previous plates. While a close comparison shows more marked pocketings in this, Plate VI looks nearly as pathological.

COMMENT. Examination of the five plates demonstrating shotlike appearance of glands shows that without a normal control, it would be impossible to tell which were abnormal. Plate VII and IX cannot be differentiated by the sialograms and yet they are clinically the opposite. Plates VIII and X are a little more on the pathological side and yet Plate VI shows essentially the same condition and also shows some abnormality of the duct (may be due to injection).

We therefore feel that the shotlike appearance of parotid glands does not mean either a normal or abnormal condition unless the clinical diagnosis corresponds. We also feel that this is not a sign of hematogenous infection as we had at first hoped. Further studies are necessary in order to establish the status of this sialographic entity.

Case VI. Miss G., age fifty-eight years was seen July 19, 1933. This patient developed a bilateral swelling of the parotid glands in February, 1933. This continued off and on until the date seen. At this time the temperature was normal, both glands were swollen, both duct orifices were red and pouting. The ducts were dilated on alternate days from July 19 to July 30, 1933. On August 12, 1933 both glands were normal in appearance and patient was free from pain.

Case VII. Mrs. T., age sixty-two years was seen September 2, 1933. This patient developed swelling of the right parotid in April, 1933. This condition was present off and on until seen. At this time the temperature was normal. There was diffuse swelling of the right gland with redness and pouting of the right orifice. She was dilated when seen and again September 7. October 1, 1933 the swelling was completely subsided and all symptoms relieved.

Case VIII. Mr. B., age sixteen years was seen August 2, 1935. This was a case of mumps showing bilateral swelling with normal duct orifices. The duct was dilated on numerous occasions to see if the condition could be alleviated but no effect was noted. This last case is reported merely to emphasize the difference between ascending and hematogenous infection no matter what the organism. The result was as expected.

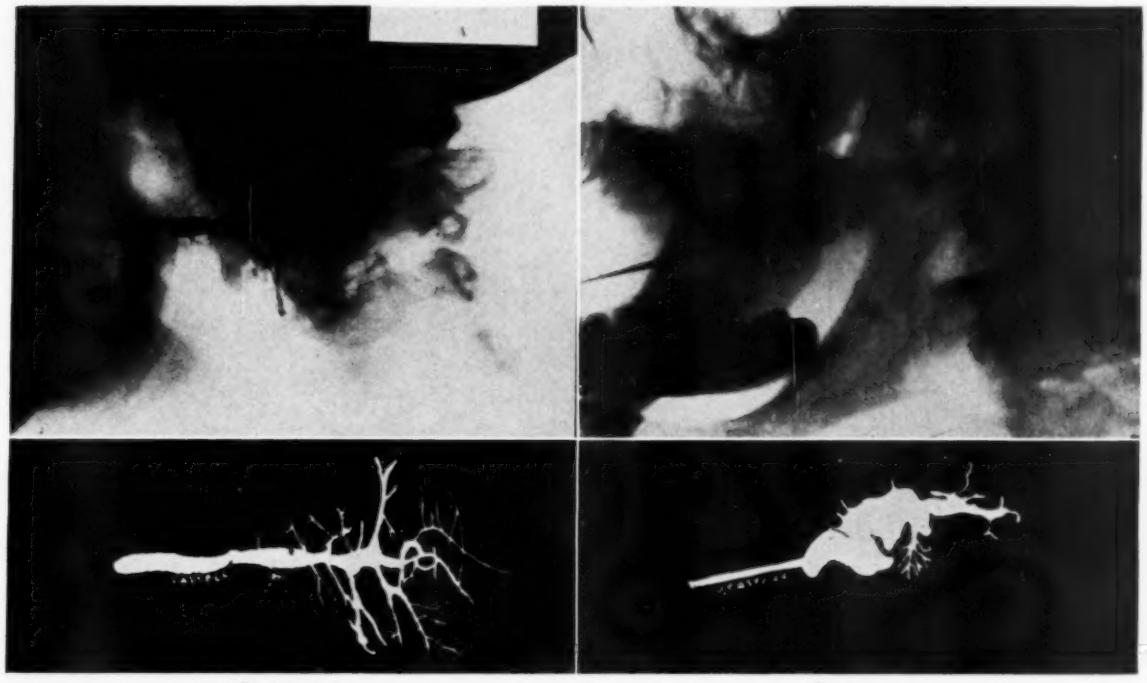


Plate XI. Plate XII.

ABNORMALITIES OF DUCTS OR DUCTULES

Plate XI. Case IV. (Fig. 6 Original Report.)[10] This represents a parotid with the history of a definite ascending infection. It was treated by dilatation with recovery.

It is noted that the pathology is mostly confined to the larger ducts. The size of the main duct may be attributed to the dilatation. The marked irregularity however, is undoubtedly caused by the infection.

Plate XII. Case IX. (Fig. 11 Original Report.)[10] This represents an infected gland of the ascending type, which had persisted with remissions for about one year. When seen the duct orifice was pouting and red and thick mucilaginous flakey secretion could be expressed. Dilatation and lavage resulted in a clinical cure. It is noted that there is a large dilatation of the duct. In the absence of calculi it is felt that a persistent low grade infection was the chief etiological factor. The peripheral detail does not show, but this is probably due to lack of sufficient lipiodol rather than to peripheral obstruction.

SUMMARY OF CASES

Five cases of acute inflammation of the parotid gland are reported. In 4 of these the criteria necessary to denote ascending type of infection were seen. Treatment in 3 resulted in prompt cures. One case was in a moribund patient where the infection of the parotid was but one factor in a general disintegrative process. We feel that the

mortality was unavoidable and that the parotid had little or no part in it.

In the remaining case, a diagnosis of hematogenous infection was made. This subsided with the application of cold compresses and later heat by means of a thermolite. The duct was very carefully left alone.

The case of mumps is not included in the above summary and is merely cited as a point of general interest.

Two cases of chronic inflammation of the parotid are reported which were treated by dilatation as indicated by the appearance of the duct orifice. Both cases were completely relieved.

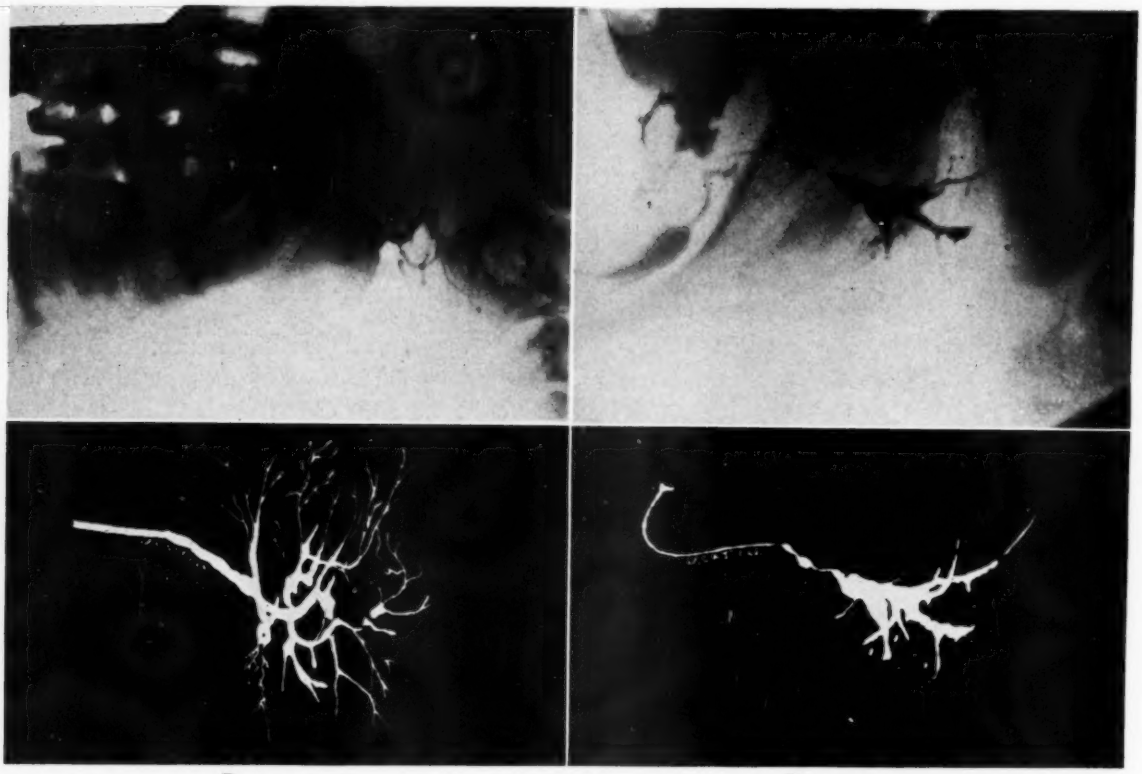


PLATE XIII. PLATE XIV.

PLATE XIII. Case VI. (Fig. 8 Original Report.)[10] This represents an infected gland following an attack of grippe one year previously. The condition had recurred every few weeks during this time. Treatment by the usual methods was without relief. When seen there was slight swelling over the parotid with prominence of the duct orifice but no sign of acute inflammation. Normal saliva could be expressed from the duct. Dilatation resulted in complete clinical cure.

The sialogram shows dilatation and pocketing of the larger ducts. The peripheral detail appears normal. This plate clearly indicates the use of dilatation.

PLATE XIV. Courtesy of Dr. George W. Christiansen, Detroit, Michigan. This patient, a female, age fifty-five years developed a right parotitis seven years ago. This persisted to some extent during the entire interval. In March, 1935, she developed bilateral mumps followed by bronchitis and pleurisy. May 18, 1935, acute edema of the right parotid developed. This gradually decreased to a low grade inflammatory condition and was also accompanied by some inflammation of the left side. The ducts were dilated and mercurochrome instilled on several occasions with marked improvement of the left side and some improvement on the right side. There was still edema on the right side however, when last heard from the patient, October 15, 1935. Examination of the sialogram of the right parotid reveals a striking similarity to Plates XII and XV, being about midway between the two conditions. The use of dilatation was clearly indicated in this case as explained in our discussion of the treatment of chronic infection.

RESULTS

Statistics on such a small series are of no value. Our results speak for themselves. Before a true evaluation of this method can be made further study is necessary. At the present time however, we feel that our method of treatment is physiological and superior to any yet suggested.

SIALOGRAPHY

Great interest has been manifested in the use of sialograms. Barsky and Silberman,[2] Kim, et al.,[12] Simon[16] and others have used this method of delineating parotid pathology and especially tumors. The technique has been essentially the same. Most writers stress the necessity of dilating the duct prior to injection. We only dilate the duct when necessary, as in very old patients with atrophy of the tissues. In none of the patients since our original series have we had to use dilatation. We use a blunt 22 gauge 2 inch needle.

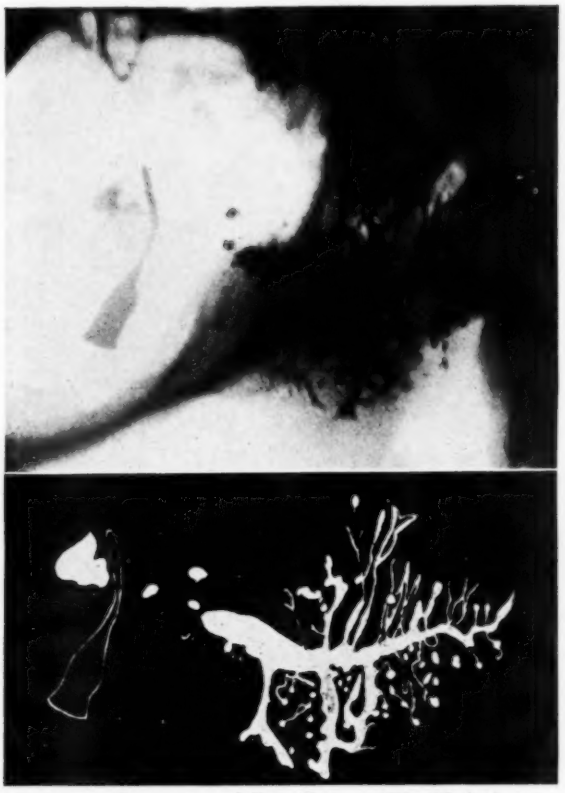
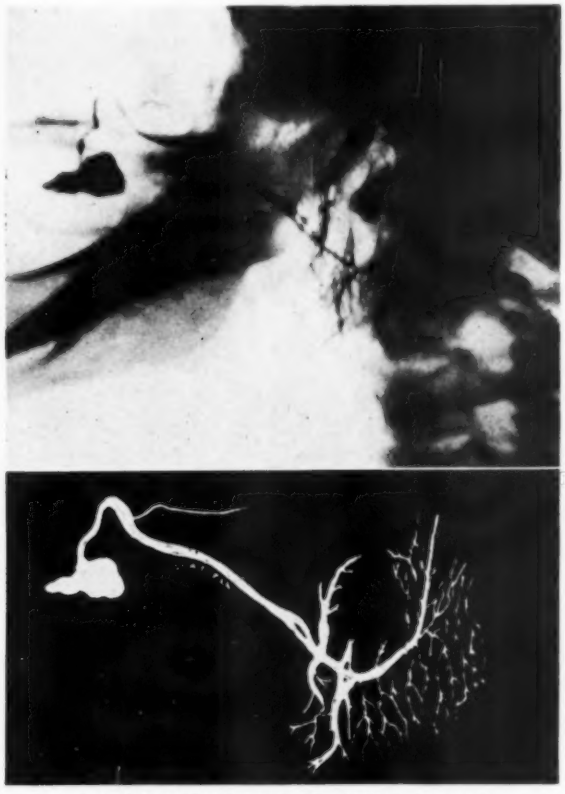


PLATE XV. Courtesy of Dr. George W. Christiansen, Detroit, Michigan. This is the picture of the left parotid of the patient in Plate XIV. The evidence of previous infection with irregular dilatation of the ducts is well demonstrated. The reason for the more rapid clinical improvement as compared to the other parotid is to be expected from the pathology shown. This resembles Plate II and the results. These cases parallel each other.

COMMENT. Examination of the sialograms reveals the pathology which one would expect. Acute infections which subside immediately would show little or no pathology. Chronic infections, especially with acute recurring exacerbations produce demonstrable abnormalities in the size and outline of the main ducts, which are clearly delineated in the plates. It is striking that in those cases which were resistant to treatment, impediment to the outlet of saliva was always present. This resembles infection above a ureteral stricture.



SIALOGRAMS OF TUMORS OF THE PAROTID

PLATE XVI. N. M., female, aged forty-five years, picture taken August 1, 1935. This patient had a mass just below and anterior to the left ear. It was round, firm and apparently embedded in the parotid gland. The skin was freely movable over the mass. The patient had had no trouble from this condition aside from the cosmetic effect. The sialogram shows a normal gland and ducts with a deformity in outline in the proximal part of the gland characterized by a pushing aside of the normal tissue rather than a break in the outline of them. This crowding is most marked superiorly and peripherally. A diagnosis of encapsulated tumor is evident. August 5, 1935, Dr. Charles D. Squires removed an encapsulated mass about an inch in diameter. The tissue was spongy, homogenous in character and shelled out very readily. Convalescence was uneventful except for a salivary fistula which closed after irradiation. No facial paralysis ensued.

PATHOLOGICAL REPORT. Mixed tumor of the parotid. This should be compared with Plate I which is the sialogram of the normal parotid.

The operator stands on the side opposite the orifice (left side for right parotid and vice versa) with the patient lying on his back. The buccal mucous membrane is carefully dried and the duct orifice noted. The needle attached to the syringe con-

taining 1.5 c.c. of lipiodol can usually be passed 1 to 1½ inches without difficulty. Simon[16] states that an olive tip is necessary to prevent regurgitation. We always have a backflow into the mouth but have failed to visualize a gland in only one case. This occurred in one of the parotid tumors (Plate XXII) where the entire cheek was rigid from *x*-ray treatment. In this case the rigidity of the tissues was such that the angle of the mouth cracked and bled when the cheek was retracted enough to demonstrate the duct orifice. The needle was passed without dilatation being necessary, but pain was severe after 3 mm.

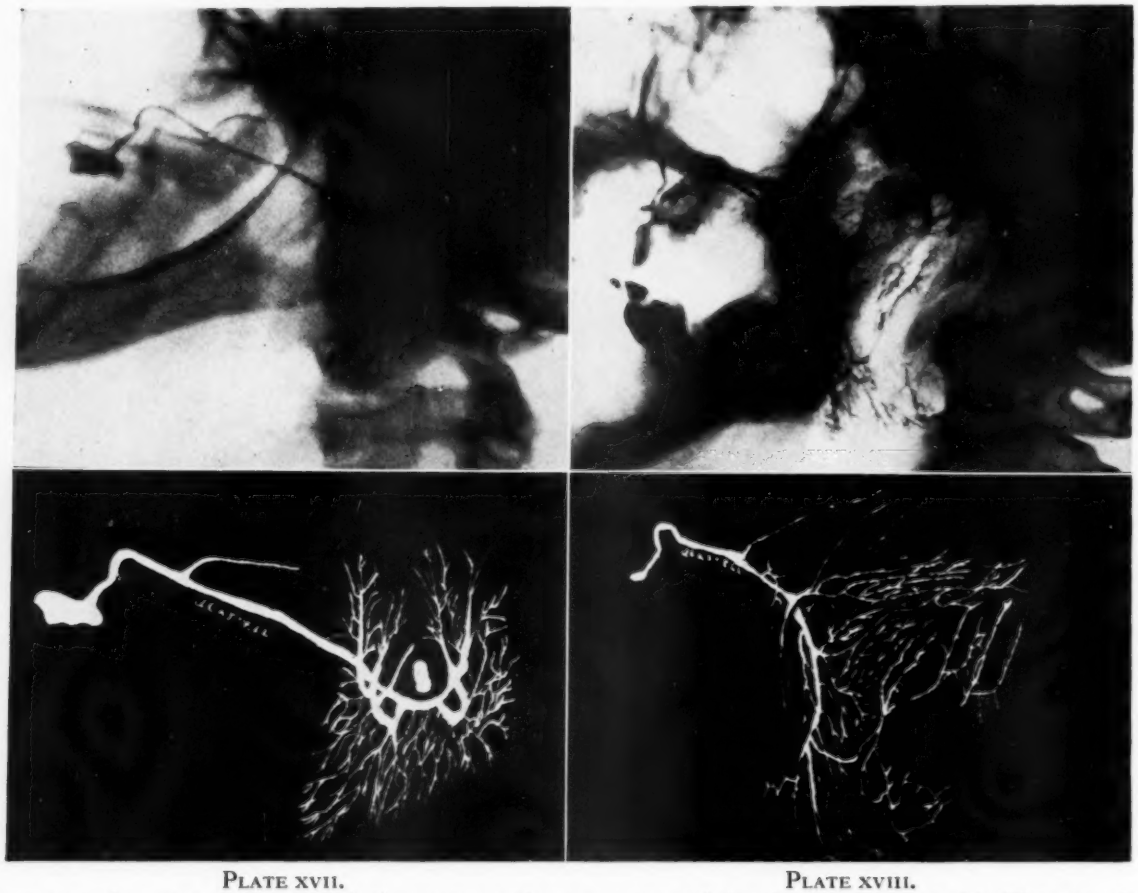


PLATE XVII. PLATE XVIII.

PLATE XVII. August 29, 1935. This is the postoperative appearance of the gland demonstrated in Plate XVI. It is noted that the filling defect is less marked and that the normal appearance tends to return even at this short interval. The blob of lipiodol in the centre probably represents the point at which the normal tissue was cut. It is probable that the opening of the salivary fistula began at this point also.

PLATE XVIII. J. C., male, age thirty-seven years was seen November 14, 1935. This patient developed a sudden swelling in the left parotid region during an attack of severe vomiting about seven months ago. This was accompanied by pain which only lasted a short while. The mass has persisted ever since and has caused no subjective or objective symptoms aside from the constant deformity.

Examination shows a round cystic mass just below the left ear, which seems adherent to the parotid gland, but which is movable. The overlying skin is free. The sialogram shows normal duct and ductules with peripheral detail well defined. At the extreme periphery there is a filling defect corresponding to the cystic tumor. The lattice work appearance caused by crowding normal ductules is well demonstrated. A diagnosis of encapsulated tumor seems indicated.

On operation, November 20, 1935, the tumor was found embedded deep in the gland requiring section of this before being seen. This was encapsulated and was readily enucleated by blunt dissection and with the finger. The capsule was adherent posteriorly and was broken through at this point. The tumor was about 1½ inches in diameter and consisted of a periphery of glandular tissue about ½ inch in diameter surrounding fluid which suggested an old haemorrhage. Convalescence was uneventful except for a salivary fistula which is being irradiated. No facial paralysis has developed.

PATHOLOGICAL REPORT. Mixed tumor of the parotid.

The solution is injected slowly, 1 or 2 mm. at a time. The patient feels fullness or pain as the solution enters, which subsides on cessation of pressure. When either a slight fullness of the gland occurs, or the patient complains, the injection is concluded. We have had no ill effects beyond a soreness which lasted from one to four hours. The intermittent injection permits more fluid and therefore better visualization. The needle is then withdrawn, the mouth carefully wiped free of

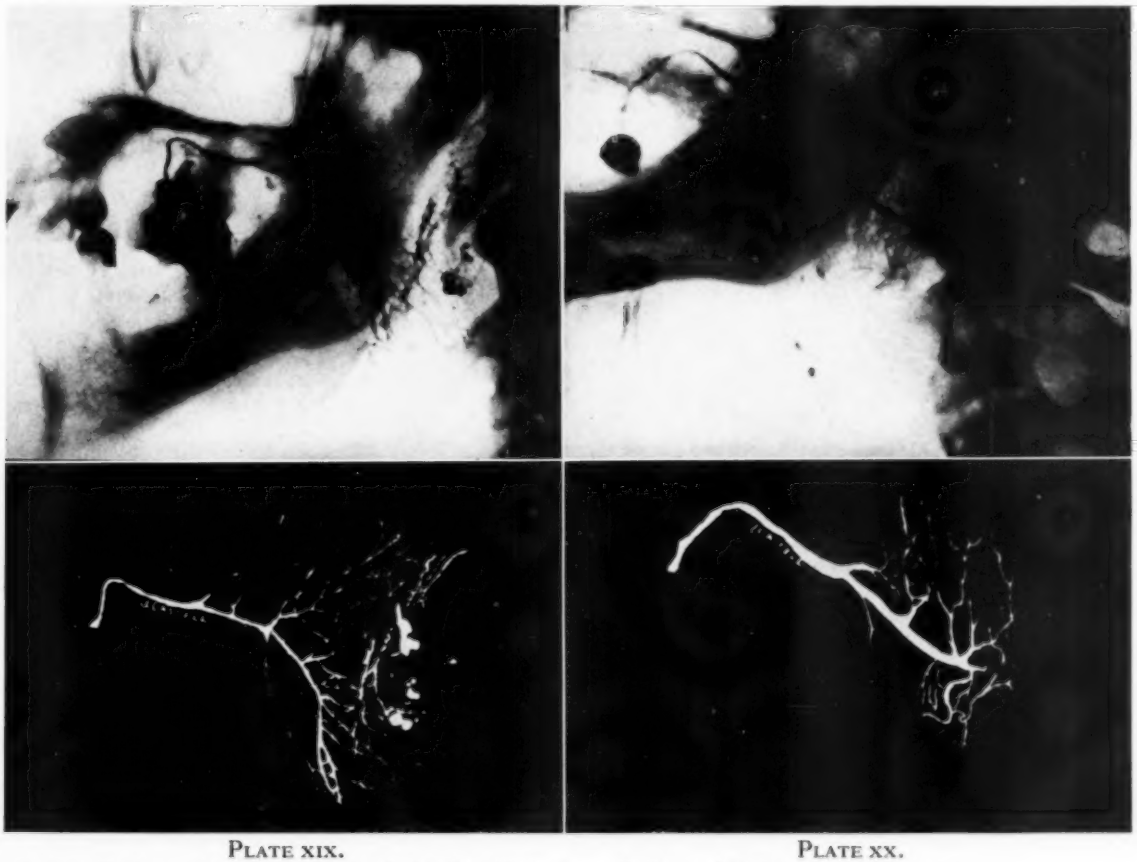


Plate xix. Plate xx.

Plate xix. Postoperative appearance of gland in Plate xviii. Salivary fistula present.

The sialogram shows normal ducts, ductules and peripheral detail. The filling defect is still present but is smaller. Lipiodol rests show where the normal structure is broken and may point to the beginning of the fistula. It is noted that the ductules about this area visualize (permit entrance of Lipiodol better) than in the preoperative picture. This is best demonstrated at the lower part of the periphery.

Plate xx. R. S., male, age forty-seven years, seen October 17, 1935. This patient had symptoms referable to a slow insidous facial paralysis which took approximately eight months before being clinically recognizable. He had lost about sixty pounds during this time. He had no pain and no symptoms pointing to the parotid region aside from a small, hard, irregularly nodular mass below the ear and between the mastoid and the angle of the jaw. When seen the left facial paralysis was quite marked, with inability to close the eye. The tumor mass was so hard that a diagnosis of cartilagenous deposits in a mixed tumor of the parotid was made. The tumor seemed adherent to the underlying tissues and to the parotid. It was not movable nor tender. The overlying skin was free. The probability of malignancy was also considered. The sialogram shows normal ducts, ductules and peripheral detail. The distal lower portion shows an abrupt ending suggesting pressure. No filling defect in the gland itself is noted. At operation, October 29, 1935, a hard inflammatory mass was found, which was freed with great difficulty from the mastoid and parotid. This had apparently invaded the facial nerve and the surrounding tissue. The mass felt cartilagenous but on section did not look like cartilage. It was removed piece meal until the facial nerve was demonstrated at its exit from the foramen. It was impossible to tell whether this was intact or whether we had removed part of it since there was no reaction to stimulation peripherally. It was felt that the tumor was probably malignant. The patient's convalescence was uneventful. The facial paralysis has improved slightly, but the patient states that he feels much better, that he can close the eye better and that sensation is returning to the cheeks. From our operative findings we would expect little if any improvement. Pathological report from the laboratory at the Binghamton City Hospital and also from the Institute for Malignant Diseases at Buffalo, New York states that there is a chronic inflammatory reaction about a ganglion. The Wassermann is negative.

the solution, and the patient put in position and pictures taken. As suggested by Dr. B. Wulff of the *x*-ray Department of the Binghamton City Hospital, true laterals are taken and have been found to be satisfactory in every way. If bilateral films are taken, the duct injected is carefully milked before injecting the other. We have not done stereoscopic films as suggested by Kim, et al.[12]

Simon[16] uses 40 per cent iodipin and injects 2 to 5 c.c. Our plates demonstrate

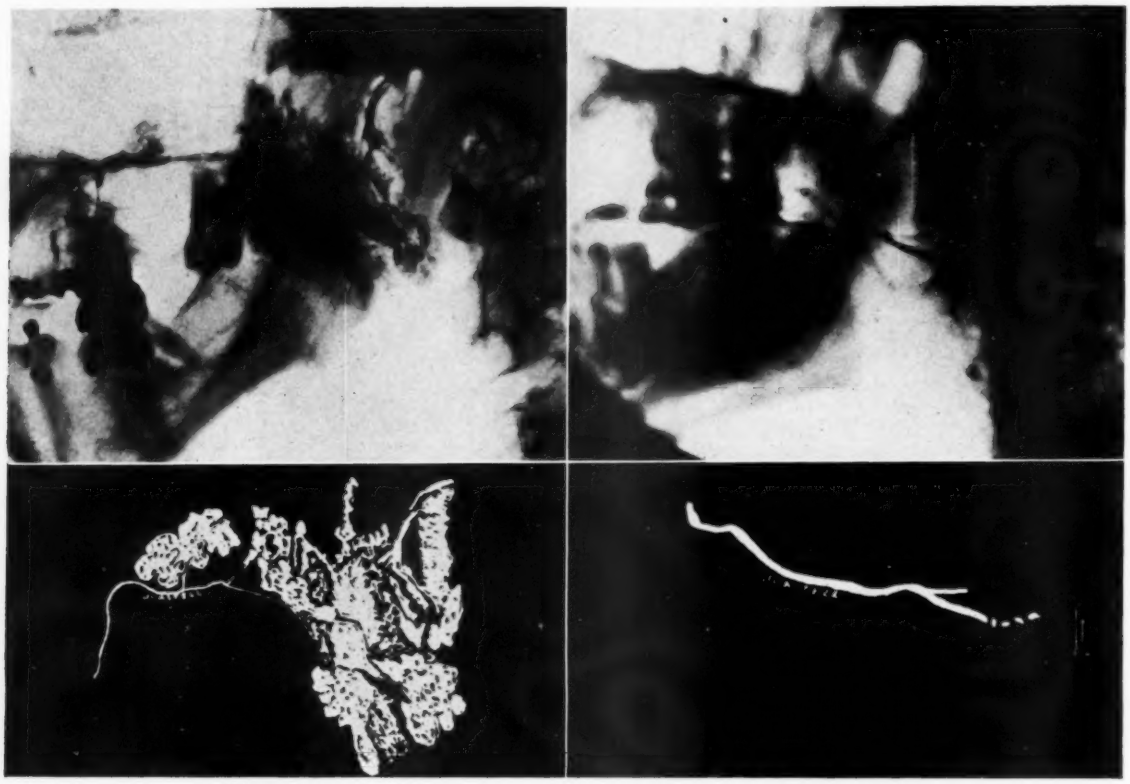


PLATE XXI. PLATE XXII.

PLATE XXI. R. R., male, age thirty-seven years, has had a tumor in the right parotid region for several years. He has had intensive *x*-ray treatment both at the Binghamton City Hospital and at Buffalo. When seen he showed marked induration of the parotid area but with no definite tumor present.

The sialogram shows a well developed, accessory gland. The ducts are normal. The glandular tissue presents a homogenous fluffy appearance unlike any other glands which we have previously seen. Comparison with Plate II which is the normal side, demonstrates clearly that there has been a marked change. No filling defect is noted, except possibly a slight distortion at the upper outer part. We are at a loss to explain this plate. We feel however that the tumor mass has probably invaded the gland. The *x*-ray appearance may be due to fibrosis caused by the irradiation. This is the first picture which we have taken which clearly shows the peripheral structure of the accessory gland.

PLATE XXII. F. D., male, age seventy-two years was operated in April, 1932, removing a squamous carcinoma of the skin just below the right ear. He remained well until 1934, when he began to have pain in that area and noted a swelling in the scar, which gradually enlarged. Examination showed a hard, rounded mass about an inch below the ear, firmly adherent to the overlying skin. It was considered to be a recurrence of the original condition and was excised November 8, 1934. At operation it was found that this tumor had involved the sternocleidomastoid muscle and the surrounding tissue. The mass was excised with as much normal tissue as possible, but it was felt that removal was not entirely complete. The parotid gland and facial nerve were not seen during the operation. The patient has received intensive *x*-ray treatment and at present the condition seems stationery.

PATHOLOGICAL REPORT. The tumor was a mixture of squamous cell epithelioma and mixed tumor of the parotid gland. The sialogram shows only the main duct. This is demonstrated not as a parotid tumor, but as an example of a case where there was so much scarring of the tissues that a proper injection could not be done. As stated before, only 3 mm. If lipiodol caused so much pain that injection had to be discontinued.

COMMENT. Our series of tumors is so small that it would not be fair to do anything but generalize. We agree with Kimm[12] and his associates that by means of sialograms it is possible to determine whether or not the gland is involved and the location and the extent of the involvement indicated. We must modify this last statement in view of Plate XXI by adding these words—"In the absence of intensive *x*-ray treatment."

that smaller amounts of lipiodol will suffice. This agrees with the other writers.

The comments on the value of sialography by various authors have been read by us with great interest. Interpretation of the films is admitted as being still unsettled. Our complaint has been that the detail which enabled the writer to make his diagnosis was often obscured in the publication. This is a fault which is referrable not only to sialograms. Because of this we take the liberty of submitting sialograms of normal and abnormal glands accompanied by silhouettes made from the film by Dr. John W. Castell of the Binghamton City Hospital staff. In this way it is hoped that the reader may visualize the details which may not be clearly delineated in the print. We feel that such a procedure if routinely used will aid in establishing definite criteria for future diagnosis.

SUMMARY

1. Review of current literature has been given presenting theories of the etiology of infections of the parotid gland.

2. Experimental proof together with clinical reports have been given showing that hematogenous infection of the parotid while uncommon does occur. It has also been shown that the two types of infection can be differentiated by clinical observation.

3. Further reports have been given on the use of dilatation of Stenson's duct in infections of the parotid of the ascending type.

4. Description of our technique in making sialograms has been given.

5. Sialograms of normal and abnormal glands including tumors have been shown accompanied by drawings representing the detail of the glands which is only seen on the original negative. We feel that further studies along the lines suggested is necessary before settling the questions involved in this paper. We also urge that further studies of sialograms which are published be accompanied by illustrations so that sufficient criteria be available to the reader for making definite diagnosis in those cases.

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PREVENTION OF GAS PAINS

LOUIS E. MAHONEY, M.D., F.A.C.S.

LOS ANGELES, CALIF.

TO the patient who has undergone a surgical operation, the memory which is most distressing and persistent is that of abdominal distension, more familiarly known as "gas pains." Accounts of postoperative discomfort widely disseminated among the lay public have caused the postponement of many badly needed operations and numerous patients have succumbed without surgical treatment through fear of the pain and distress which have in the past been necessary concomitants of all abdominal operations. Any methods, therefore, which alleviate or entirely prevent these disturbing sequela are valuable additions to the surgeon's armamentarium and entirely worthy of serious study.

Before beginning the discussion of the means employed to prevent postoperative abdominal distension with its resultant chain of symptoms, a few words might not be amiss concerning the preparation of the patient and the choice of anesthetic.

In our experience ethylene and spinal anesthesia have proved most satisfactory. Both require the services of expert assistants and when for one reason or another such highly skilled associates are not available, ether administered through a face mask and by the open drop method is undoubtedly the safest drug for all around usage. Should ethylene fail to produce proper relaxation small amounts of ether may be used at intervals. With the proper selection of risks and in highly skilled hands, spinal anesthesia is as safe as any method in current use. We have never experienced any difficulty in its application, nor in a fairly large surgical experience do we have any personal knowledge of complications which could be fairly and truthfully ascribed to this procedure. From the technical standpoint, spinal anesthesia affords the best relaxation and is the most generally satisfactory agent for all abdominal surgery. Local anesthesia is eminently useful but requires assistants and nurses thoroughly trained for the purpose as the technique differs radically from general anesthesia. Nitrous oxide is mentioned only to be condemned as it depends for its effect largely upon anoxemia with resultant cyanosis and is extremely dangerous.

The proper mental attitude in the patient is quite important and in this particular field, the surgeon by his personality and management can do wonders to render the postoperative course smooth. A good night's rest before operation should be ensured by the administration of any hypnotic such as sodium amytal or neonal in suitable dosage. A preliminary hypodermic injection of morphine and atropine given one to two hours before going to the operating room will reduce the amount of anesthetic needed and check sweating, salivary, bronchial and intestinal secretion. Sodium amytal orally or intravenously in amount sufficient to dull the sensorium is very valuable in nervous individuals. No cathartics should be given before operation and if it seems desirable and necessary to empty the lower bowel, this is accomplished with least disturbance to the patient by a simple cleaning enema the night before.

It is, of course, assumed that the necessary surgical procedure will be performed in the gentlest fashion possible and with the minimum insult to tissues and in a reasonable amount of time. Probably excessively slow surgeons are as dangerous as are those individuals who sacrifice meticulous care in the interests of speed and brilliancy of technical maneuvers. Taking

for granted that the operation is well planned and properly executed, it may properly be asked what further steps can be taken to minimize postoperative discomfort.

In a surgical experience extending over more than a decade we have had occasion to participate as an assistant or as the principal in more than 1500 laparotomies in various hospitals and have been much interested in postoperative complications and their preventions. We have lavaged stomachs, prescribed enemata of sometimes fearful and wonderful compositions, used pituitrin eserine sulphate, atropine, hot stupes, heat cradles, etc., and have often felt that we were doing our patient more harm than good by the treatment. In our formative period, we served for the most part under surgeons who did not permit their patients to have water by mouth for twenty-four to seventy-two hours after the operation. On the third or fourth day, the usual hospital liquid diet, ordinarily tea, orange juice, lemonade, grape juice, milk, etc., was allowed and on the fifth to seventh or eighth postoperative day, the standard soft diet was ordered. Many surgeons did not allow a full tray, or so-called general diet, until just before the patient went home or even imposed rigid dietary restrictions for a considerable period during convalescence. Almost without exceptions, large amounts of normal saline or glucose solutions were given either subcutaneously or intravenously to the patient's great discomfort. Enemata of various sorts were prescribed so often to relieve the gaseous distention which invariably followed this type of management that private feuds developed between the patient and the nurse assigned to this thankless duty. All in all the postoperative course produced few pleasant memories and the wide publicity given these soul stirring and dramatic experiences has undoubtedly dissuaded many susceptible or fearful individuals from necessary and life saving operations. We have long felt that most of this suffering could be avoided, that much of this treatment was meddlesome if not downright harmful and have for ten years been evolving a system of postoperative management based upon the principles of normal physiology which renders the ordeal of an abdominal operation much easier for the patient to endure.

The human intestinal tract is a muscular tube, the mucous membrane of which secretes digestive ferments and the motility of which is largely dependent upon these ferments and the presence and character of the food material in the bowel. Activity of the liver, the chemical engine of the body, and the secretion of bile is greatly influenced by the amount and the variety of ingested food. Whenever starvation supervenes, and the usual hospital liquid diet is really semi-starvation, the bacteria normally present in the bowel increase enormously and produce large amounts of flatus. If lack of the food to which the upper bowel is accustomed continues for more than a very few hours, those species of bacteria normally resident in the colon and cecum ascend into the ileum and jejunum and there proliferate giving rise to huge amounts of gas and to symptoms of toxemia from absorption. So-called "autointoxication" is a widely recognized clinical fact, as witness the universal popularity of cathartic and the symptomatic relief so often afforded by their judicious use. Practically all successful medical treatments for colonic stasis appear to depend for their efficacy upon lowering or modifying the bacterial content of the colon. As long as these fecal bacteria are largely limited to the lower bowel, they are not of great importance but once they spread to and grow luxuriantly in the terminal ileum and jejunum, they become a fruitful source of trouble and produce a stormy postoperative convalescence.

The factors in health and normal well being which keep down the growth of these organisms are bile, the hydrochloric acid of the stomach and the digestive ferments powerfully aided by the peristaltic action of the bowel which endeavors to move the food taken in by mouth as far as the ileocecal valve in about six hours or less.

Necessarily if we add starvation, or semi-starvation in the form of the usual hospital "liquid diet," to the systemic shock of an abdominal operation, we are decreasing the secretion of hydrochloric acid, of bile and the digestive ferments, or perhaps abolishing temporarily these activities altogether and in addition markedly diminishing peristaltic action, thus favoring the multiplication of putrefactive and gas producing organisms and doing everything possible to produce abdominal distension in the mild case and adynamic ileus in the severe. A vicious circle is set into motion and the more gas formed, the less able the small bowel is to expel it owing to the unfavorable factors of excessive stretching and toxic absorption. Nature's effort to overcome this handicap consists of excessive and vigorous peristalsis, i.e. "gas pains." If for any reason whatever, peritonitis, inherently weak musculature, surgical shock, loss of body heat during the operation, too much anesthetic, etc., the small bowel becomes paralyzed and atonic with absent peristalsis, we have progressed from the stage of "gas pains" to that most dreaded complication, adynamic ileus.

It has long been taught that the best treatment for abdominal abscess is a quiet bowel and that peristalsis spreads infection and causes peritonitis. In contrast to this belief, we have felt that death due to general peritonitis was caused by intestinal obstruction produced by adynamic ileus rather than from absorption of toxins from the infecting organisms. A logical corollary to this view would direct treatment towards prevention of abdominal distension. Certainly to the practicing surgeon the most encouraging indication of improvement in desperate postoperative conditions is diminution of abdominal distension. Few of us worry much about a flat abdomen.

We recognize that these opinions run counter to the bulk of surgical teaching and to the beliefs of the majority of surgeons. However, the results in our efforts to restore the normal activities of the gastrointestinal tract immediately following operations have been so successful in more than 300 laparotomies for various pathologic entities that we feel no hesitancy in advancing them for the general notice of the profession. To observe a patient propped up in bed, with smile on his face eating with relish from a full tray on the morning after the removal of an acutely inflamed appendix is a thought-provoking spectacle. Briefly our method is about as follows with such modifications as may be made necessary by different conditions and varying temperaments.

Patients are urged to eat solid food very soon after operation, usually the next morning. If not nauseated, they are served a tray the evening of the operative day and encouraged to partake of dry toast, jello, cream of wheat and similar articles. Water is permitted by mouth in such amounts as the patient may desire as soon as the nausea has disappeared. When ethylene or spinal anesthesia has been employed, this is usually within one or two hours after the return from the operating room. Where ether has been used, water is ordinarily taken two to four hours afterwards. Sufficient morphine or pantopon is administered for the first two or three days to control pain. After the first night, some sedative of the barbital group is given for restlessness and to assist sleep and thus reduce the amount of opiate needed. Fruit juices of all varieties are strictly interdicted as it is felt that they have little or no caloric value and produce intestinal fermentation and resultant gas formation.

Besides the early feeding of water and solid food by mouth, it is also extremely helpful to supply some adjuvant which will furnish bulk, retard bacterial growth and thus help to combat intestinal stasis. This purpose is best served by mineral oil in agar, with or without the addition of phenolpthalein, and one ounce of this preparation is prescribed three time daily after meals. The bowels under this management will usually move on the third day and after action has occurred the dosage of the oil can be gradually reduced until it produces one or two actions daily without leakage. This daily or twice daily bowel

movement has important psychologic and physiologic results and the patient's feeling of well being is stimulated which reflects itself in increased cheerfulness with resultant good appetite. By the use of the oil and agar mixture, enemata may be almost entirely dispensed and the patients made infinitely more comfortable. The mucus normally secreted by the lower bowel has certain lubricant properties and the use of frequent enemata of soap suds or other chemical irritants, washes out this protective coating, slows down peristalsis, assists gas formation and thus defeats its own purpose. The administration of one enema thus calls for another and the patients rest is greatly disturbed and the convalescene lengthened. In the last 28 laparotomies performed I have had occasion to prescribe only two enemata and these were given to a patient who had been using mineral oil for severe constipation previous to the operation and it is highly probable that the amounts ordered were insufficient for this particular individual.

By permitting the early ingestion of water, forcing the feeding of solid food and adding a bulky ingredient to the feces which possesses lubricating properties, other beneficial side effects are obtained. Normal saline and hypertonic glucose solutions undoubtedly have a great field of usefulness but it is our personal conviction that these agents are employed far more often than needed following operative procedures and that frequently amounts are given which impose definite handicaps upon a critically ill patient. When water and solid food can be taken and retained, there is far less necessity for the administering of these fluids by the intramuscular, subcutaneous and intravenous routes. The pain arising from insertion of needles and the soreness resulting from the injection of large amounts of normal saline or glucose under the skin of the breasts, axilla or groin not infrequently is the source of more distress to our patients than is the site of the operation. Proctoclysis, or the giving of glucose and soda solutions per rectum has been practically discarded for the reason that absorption from the mucosa of the colon is very slow, and the early taking of water by mouth renders this mode of treatment entirely unnecessary.

Patients are encouraged to move about in bed as much as possible and to help themselves in every way as it is thought that early muscular activity promotes peristalsis and possibly might help to prevent the formation of adhesions. Needless to add, the mental effect on a patient when he or she finds that they are not entirely dependent upon the nurse is excellent and is reflected in increased cheerfulness, better appetite and quicker recovery.

Another interesting side effect of the treatment outlined is the fact that not as much weight is lost as when the older, standard methods are employed. Ordinarily a loss of anywhere from ten to twenty pounds is expected after an abdominal operation but with this regime, this figure can be greatly lessened, in fact, so much so, that frequently two weeks after their surgery has been performed many patients will have been found to have regained weight to within five pounds of the figure approximated when they entered the hospital. This naturally assists in the earlier return to an useful economic life.

As can readily be seen, the regime described is extremely simple and avoids unnecessary treatments and fussing with patients. We have often observed that saline injections, enemata, etc., have been ordered by attending surgeons when a little nap for the patient and a book to keep the nurse occupied would have accomplished a great deal more. In this connection, it might be remarked that nurses require careful instruction as from past training, they are likely to feel that they are not doing their full duty unless kept very busy. Tact, kindliness without oversentimentality and the avoidance of discussions by visitors of their terrible sufferings and dreadful "gas pains" will do wonders to keep your patient in the right frame of mind and amenable to your directions.

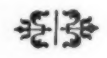
We fully realize that many of the ideas expressed run counter to the surgical teachings of the last twenty-five years and to the usual practices of the present day, but in our hands these methods have resulted in a very low mortality rate and in short, uneventful convalescent periods. With the single purpose of advancing the art and science of surgery through bedside, clinical research, we earnestly present these methods to the profession for consideration and study.

SUMMARY

Gas pains are the most distressing postoperative complication. Proper preparation of patient and extremely gentle operative manipulations are very important.

Ordinary postoperative treatment and usual dietary regime predisposes to gas formation. Hospital liquid diet is semi-starvation and causes proliferation of putrefactive and gas forming bacteria. Liquid diet is to be avoided and water and solid food given at once. Mineral oil is prescribed and enemata avoided.

The result is good appetite, no gas pains, bowel movement on the third day, very little loss of weight and earlier return to work.



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FRACTURES OF SHAFT AND NECK OF FEMUR*

REPORT OF 119 CASES

IRWIN E. SIRIS, M.D. AND C. JOSEPH DELANEY, M.D.

Associate Visiting Surgeon, Bellevue Hospital; Attending Surgeon, Beth-Moses Hospital, Brooklyn

BROOKLYN, N. Y.

Assistant Visiting Surgeon, Bellevue and Willard Parker Hospitals; Jr. Assistant Visiting Surgeon, Knickerbocker Hospital

NEW YORK, N. Y.

THIS study comprises the results of 119 cases of fractures of the femur including 4 of the neck which were admitted to the Children's Surgical Service in Bellevue Hospital during the six year period, January 1st, 1930 to December 31st, 1935. The analysis includes the age, type and location of the fracture, radiographic findings, method of treatment and the observations made in our return clinic.

During the past six years the Russell method of suspension and traction in the treatment of fractures of the femur has gradually supplanted the generally accepted procedures of the plaster spica and continuous adhesive traction for children older than six years of age and to some extent the Modified Bryant's Overhead Pulley suspension for those under six years as previously recorded by Burdick and Siris.[1] Soon after the Russell method of treatment of fractures of the femur was introduced on the service the procedure was endorsed because of the simplicity of its application and the generally good results in alinement of the fragments and early restoration of normal function. This improvement in results can be attributed partially to the ambulance surgeon's obligatory application of a Thomas splint to the fractured extremity during transportation to the hospital. This method of procedure has resulted in satisfactory and frequently excellent anatomical reposition of the fragments, early proliferation of callus, firm union, without any appreciable delay in return of movement in the knee or hip or atrophy of the muscles.

AGE

The comparative frequency of fractures of the femur in various ages is enumerated in Table 1, where attention is also drawn to the methods of treatment employed and to the frequency of the application of Russell Traction in extremely young chil-

TABLE 1

AGE INCIDENCE AND METHODS OF TREATMENT

Bryant's Overhead Pulley Suspension		Russell Traction	
Age	No. Cases	Age, Years	No. Cases
7 months	1	2½	1
9 months	3	4	2
10 months	1	5	14
1 year	4	6	18
2 years	6	7	8
3 years	8	8	14
4 years	5	9	7
5 years	2	10	1
		11	4
Total	30	12	3
			72

Plaster Cast and Traction		Russell Traction Followed by Plaster Cast		
Age Years	No. Cases	Age Years		No. Cases
6	2			
7	3	5	7 days in Russell Traction then P.C., Poliomyelitis	1
7—refractured 12 weeks cast	1			
8	2	10	10 days in Russell Traction then P.C., Vaginitis	1
10	3			
11	2			
12	2			
Total	15	Total		2

* From the Children's Surgical Service, Bellevue Hospital.

dren. The youngest child was two and one-half years of age, 43 children were under eight years of age, 2 were four years old, 14 were five years old, 18 were six years old and 8 children were seven years of age. The excellent results obtained in children between the ages of eight and twelve years, by means of Russell Traction, suggested its application in younger children, particularly so because of the persistence of overriding in many of the fractures treated by the Modified Bryant's Overhead Pulley Suspension.

TYPES OF FRACTURE

Two of the 119 cases of fracture of the femur were compounded, and three children sustained fractures of both femurs. In Table II is shown the types of fractures

TABLE II
TYPE OF FRACTURE OF FEMUR

	Total Number of Cases	Type of Cases Treated by Russell Traction
Transverse (impacted 1)	56	30
Oblique (comminuted 15)	32	20 9
Spiral (comminuted 8)	31	22 8
Total	119	72

in the entire series and the number of each group that were treated by means of Russell Traction; of these 30 or 42 per cent were transverse, 20 or 28 per cent were oblique and 22 or 30 per cent were spiral. Eight of the spiral and 9 of the oblique fractures were comminuted.

LOCATION OF FRACTURES

In Table III is enumerated the frequency of the various positions of the fragments as they appeared in the different locations of the femur. There were 4 fractures of the neck of the femur, one was subcapital and 3 were transcervical. It is of interest to note the extraordinary resistence to injury of this part of the bone in children. Attention is called to the ability of a child with the subcapital fracture to continue to walk for two weeks before becoming disabled. (Case IX.) The 72 children with fractures of the femur that were treated by Russell Traction includes 2 or 3 per cent of the neck, 14 or 19 per cent, of the upper third of the shaft, 46 or 64 per cent of the middle third, 8 or 11 per cent of the lower third, and 2 or 3 per cent of the supracondylar region, (Case XI, Figs. 1 and 2). No fracture or separation of the lower epiphysis of the femur was encountered in this group and only one case has been recorded in the last fifteen years on this service.

TABLE III
LOCATION OF FRACTURES

All Fractures		Fractures Treated by Russell Traction
Site	No. Cases	No. Cases
Neck of femur	4	2
subcapital 1		
transcervical 3		
Greater trochanter	1	
Upper third	20	14
Middle third	68	46
Lower third	19	8
Supra condylar	5	2
Lower epiphysis	0	
Condyles	2	
Total	119	72

DISPLACEMENT OF FRAGMENTS

It is a significant fact that on admission to the hospital there was relatively no displacement of the fragments in 14 or 19 per cent of the 72 cases treated by the Russell Traction. Of these one child sustained a fracture in the upper third of the femur, 10 in the middle third and 3 in the lower third. This lack of displacement can be attributed to the obligatory application of the Thomas splint before transporting the patient from the site of accident to the wards.

Fractures of the shaft of the femur showed no uniformity in displacement. (Table IV.) Though muscle contracture and gravity are dominant factors in causing posterior displacement of the lower fragment, no characteristic displacement was noted except when a spicule of bone prevented further forward displacement of the lower fragment. This observation is at variance with the conclusions drawn from the group reported previously.[1] We attribute this lack of uniformity in displacement to the various directions in which the force of the trauma was expended in each individual case and to the proper application of the Thomas Splint at the scene of the accident. This first aid treatment undoubtedly prevented compounding in some cases and frequently realined the displaced fragments before the patient was admitted to the hospital. The seemingly good end results regardless of the method of treatment is to a great part attributed to the application of the transport Thomas Splint.

TABLE IV

DISPLACEMENTS OF FRAGMENTS OF CASES TREATED BY RUSSELL TRACTION

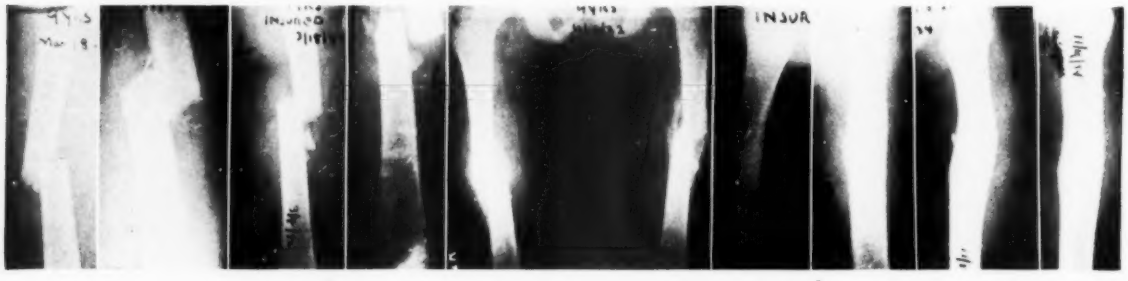
	Upper Fragments			Lower Fragments		
	Upper 3rd	Middle 3rd	Lower 3rd	Upper 3rd	Middle 3rd	Lower 3rd
No displacement	1	10	3	1	10	3
Posterior	..	1	..	3	15	2
Internal	4	4	1	6	11	3
External	5	11	3	4	4	1
Anterior	3	15	2	..	1	
Posterior and inward	..	..	..	1	3	
Posterior and external	..	..	..	..	5	
Anterior and external	1	3				
Anterior and inward	..	5				
Total	14	49	9	15	49	9

In all of our cases radiographic examinations were made immediately after the admission of the patient with the extremity immobilized in the Thomas Splint; the extent of the overriding was determined and the measurements of the extremities were recorded.

TREATMENT

1. *Modified Bryant's Overhead Pulley Suspension.* Formerly all children with fractures of the femur up to and including six years of age were suspended in the Modified Bryant's Overhead Pulley Suspension to both lower extremities. During the past six years 30 children under six years of age have been treated by this method. Although the procedure has had wide application and the results have been excellent, we have been disappointed frequently because of the failure of this method to improve the position of the fragments, for in no case did the position of the fragments become altered through the period of traction. In no instance was the overriding of a transverse or oblique fracture changed during the period of suspension irrespective of the region of the thigh to which the skin traction was applied. In our early cases the skin traction was begun at the upper end of the lower fragment. We then resorted to the application of the skin traction to the extreme upper end of the thigh as advocated by Hey Groves. His theory is based on the assumption that the combined pull of the skin, fascia and muscles as a tube will effectively exert traction and correct the position of the lower fragment. However this did not

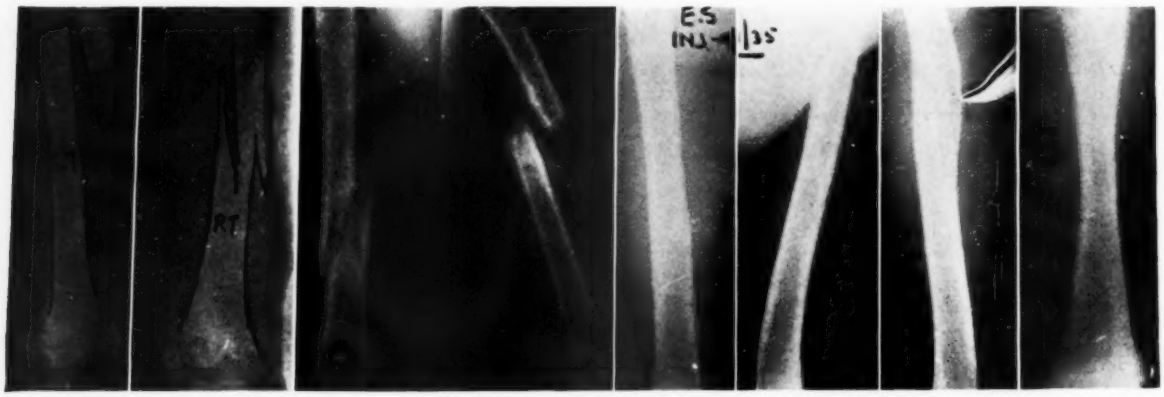
meet with any more success in our hands than the first method, for the position of the overriding fragments remained unaltered during the period of suspension in both series of cases. The application of the adhesive traction to the proximal region of the thigh by its application to a greater skin surface has continued because it has obviated the frequent changing of the adhesive and it has been found to more adequately adhere to the contour of the leg. Bryant's Overhead Pulley Suspension has a definite indication in the treatment of fractures of the femur in children under four years of age, because satisfactory position can be obtained in this group if sufficient weight is applied to keep the pelvis well off the mattress and the traction is not interrupted during nursing.



a *b* *c* *d* *e*

FIG. 1*a* and *b*, Case V. S. McG., nine years old, transverse fracture of right and left femurs. March 18, 1932, treated by Russell Traction. *c*, 1 month later. *d* and *e*, 2 years and 8 months later, no shortening, perfect function.

2. *Plaster Spica Cast with Continuous Skin Traction.* Formerly all children between the ages of seven and twelve years with fractures of the femur were placed on a Hawley Table and with the aid of a general anesthetic an attempt was made to aline the fragments by manipulation. Adhesive traction was then applied to the skin beginning at the upper end of the extremity and a plaster cast was applied to the limb extending from the lower thorax to the ankle. The patient was placed in an adult bed. The traction was continued over the foot of the bed which was elevated. At the end of six weeks the plaster cast and traction were removed. Not infrequently what appeared to be a satisfactory alinement of the fragments after reduction was found on subsequent radiographic examinations to be completely altered (Case XII, Fig. 1, 2, 3, and 4). This change we attributed to the shrinkage of the thigh from the absorption of the



a *b* *c* *d*

FIG. 2*a*, Case VI. E. S., six years old, transverse fracture of left and comminuted fracture of right femur, September 11, 1934, treated by Russell Traction. *b*, Two months later. *c* and *d*, One year and three months later, no shortening, perfect function.

extravasated blood thus removing adequate support to the fragments. This often necessitated a second attempt at reduction and application of another cast. However this second attempt at reduction was rarely successful. Though the continuous adhesive traction often prevented further overriding of the fragments we have never seen it correct overriding that existed when the plaster was applied. Any shortening of the extremity that might be present on discharge of the patient from the hospital was generally overcome by growth within two to three years and in most cases the functional results were good. We were however of the opinion that the anatomical alinement of the fragments of cases treated by this method might be improved upon.

3. *Russell Traction and Suspension.* Cases of displacement of the fragments treated by Russell Traction was not as pronounced as was encountered in those treated in a plaster spica or in the Modified Bryant's Pulley Suspension. It must however be admitted that complete anatomical reposition of the fragments was not obtained in even a third of the patients treated by Russell Traction, but in these cases the long axis of the bone fragments was more adequately obtained and retained by this method of unencumbered traction.

The orthodox procedure as recommended by Russell[2] cannot always be sustained in the case of children for we have not been able to continuously maintain the angles of traction and the pillow in their proper positions. No sooner is the angle of traction adjusted than the child is found to slide forward, so that the pulley which should be directly over the upper third of the leg is generally found to be over the patella. The proper angle of traction from under the knee is often maintained from seven to fourteen days, during which period callus has begun to form which fixes the fractured surfaces together and therefore allows the child to change position without pain. As soon as this occurs the angle of vertical traction becomes altered. The change in this angle of traction is not of great importance in children as direct vertical traction over the knee is equally effective. It is recommended that an adult bed be used in the case of children so as to minimize any likelihood of the foot spreader coming in contact with the foot of the bed and thereby interrupting the traction on the leg.

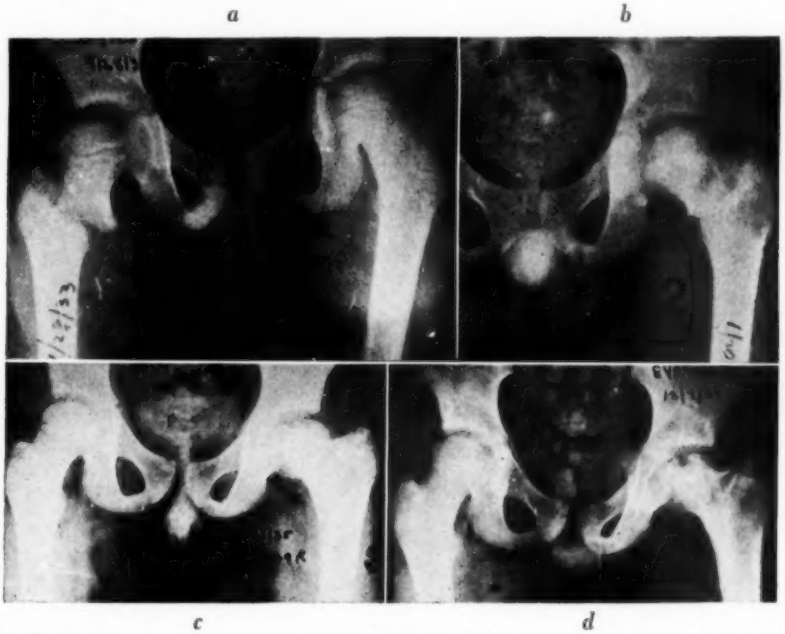


Fig. 3*a*. Case viii. M. W. eight years old, transcervical fracture of the neck of the right femur, September 28, 1933. *b*, January 20, 1934. *c*, March 21, 1935. *d*, December 7, 1935, no shortening or disability.

When Russell Traction has been used the callus has usually been found to be exuberant. Early evidence of excessive of its simplicity and effectiveness it is the treatment of choice in those under four years of age. Formerly we included in this

FIG. 4*a*, Case IX. S. W., eleven years old, subcapital fracture of the neck of the right femur, October 18, 1931, treated by Russell Traction. *b*, October 23, 1931. *c*, October 28, 1931. *d*, September 1, 1934. *e*, December 7, 1935, four years and two months after injury, no shortening or disability.

callus in cases of oblique or spiral fractures results in earlier union because of the greater fracture surface. In transverse fractures where the cortical surfaces are in contact and particularly in those having slight displacement the fracture line is soon surrounded by a ball of callus. In very young children in whom periosteal stripping could be detected by *x*-ray examination, within three or four weeks the proliferation of callus was found to extend along the under surfaces of the periosteum around the fractured ends across to the opposing fragments.

Each of these procedures of treatment has had wide application. The Modified Bryant's Overhead Suspension in the treatment of fractured femurs has advantages in very young children and because group of children treated by Bryant's Traction those up to and including six years of age. We are now however of the opinion that less overriding of the fragments and less shortening will result if children from four to six years of age are treated by Russell Traction. Further we are of the opinion that (1) Russell Traction should replace the adhesive traction and plaster spica cast for older children because it is a simpler procedure and is more efficient. (2) Through the action of Russell Traction the combined traction on the leg from below the knee and the 35° obtuse angle traction from behind the knee, with weights varying from five to ten pounds, will effectively bisect the two lines of traction and by so doing influences the elasticity of the muscles which have their

origin in the pelvis and are inserted into the tibia, thereby overcoming their pull and allowing the traction to be exerted

a *b*

FIG. 5*a*, Case x. F. D., seven years old, transcervical fracture of the neck of the femur, treated by Russell Traction. *b*, September 10, 1935.

upon the bone in its long axis. (3) As postulated by Russell, complete physiological rest of the muscles of the extremity are obtained with restoration of their equilibrium by extending the muscles to their normal length, which with the absence of interposed muscle or bone will allow the fragments to assume their normal position. (4) It permits a considerable range of motion at the knee and hip with less likelihood of muscular atrophy. (5) There is an early deposit of exuberant callus because the fractured surfaces and periosteum are irritated by the constant motion which is inevitable even though its range is small. (6) Union invariably results with the long axis of the bone in proper alinement though perfect anatomical reposition has not always been obtained. (7) Ultimately there is never any impairment of function, which is the objective.

Besides this the patients are found to be extremely comfortable in Russell Traction. Nursing, particularly the changing of linen and attention to the patient's wants, are accomplished with greater facility than when lying in a plaster cast.

PERIOD OF DISABILITY

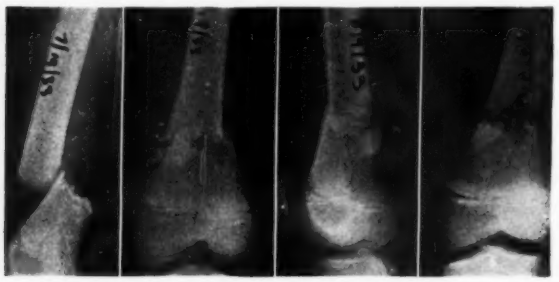
The recuperative power and the rapidity of the reparative processes of growing children is extraordinary. The pain, impairment of motion and muscle atrophy is soon overcome as shown by the disappearance of weakness in the knee.

There was practically no limitation of motion of the hip or knee joints in any of our cases of fracture of the shafts of the femur when the children were discharged from the hospital. In the majority of these irrespective of the method of treatment the children were up and about the ward by the eighth week or sooner. Mobility of the knee and hip was rarely impaired even after the application of a plaster spica and traction. With the latter method some of the children were reluctant to walk at first but generally by the end of the tenth week their limp was gone and by the third month there was no impairment of function.

SHORTENING OF FRACTURED EXTREMITY ON DISCHARGE

Twenty-two or 73 per cent of the 30 children treated by Bryant's Modified Overhead Pulley Suspension presented no shortening and 3 children or 10 per cent had evidence of 0.5 cm. shortening when they left the hospital but this was not present at the end of a year. One child or 3 per cent had a 1 cm. and another 3 per cent had a 1.5 cm. shortening, in both of these cases at the end of a year no appreciable evidence of inequality could be determined. In one case, or 3 per cent, with

a shortening of 1 cm. and in another, or 3 per cent with a 2 cm. shortening, it was two years before the extremities were of



a *b*

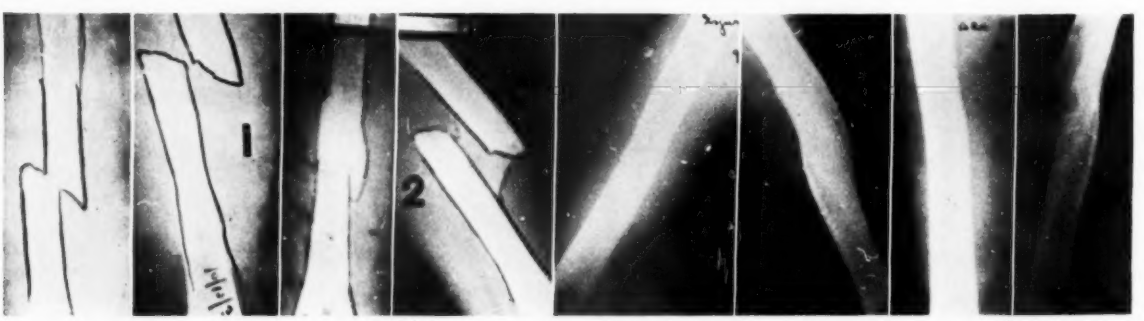
FIG. 6*a*, Case XI. L. C., supracondylar fracture of femur, July 19, 1933. *b*, August 9, 1933, twenty days after reduction with Russell Traction.

equal length. A child with poliomyelitis complicated by a fractured femur presented 2.5 cm. shortening which persisted for two years.

In this series of 119 fractures, 15 childen or 12 per cent were treated by Plaster Spica Cast and Continuous Adhesive Traction, in 9 of these or 60 per cent, there was no inequality in length of the limbs on discharge from the hospital. One child each with 0.5 cm., 1 cm., 1.5 cm. and 2 cm. shortening overcame these inequalities within two years. In one case with 2 cm. shortening it took three years before the difference in length of the limbs was no longer evident. A child with a compound fracture of the neck of the femur with 0.5 cm. shortening on discharge showed persistent evidence of this at the end of two years and five months. One case in this group could not be traced, this child had a 2 cm. shortening when she left the hospital.

Thirty-nine or 54 per cent of the 72 children treated by Russell Traction were discharged from the hospital without any evidence of inequality of the lower extremities. There was no difference in measurement of the extremities at the end of one year in 11 children or 15 per cent with 0.5 cm. and 10 children or 14 per cent with 1 cm. shortening. It required two years to overcome 0.5 cm. difference in one child and 2 cm. in another. In one child it was three years before there was no evidence of residual shortening.

There were 2 children whose fractured femurs were placed in Russell Traction and after several days they were changed into a Plaster Cast with Traction. The oldest child was ten years and was admitted with the extremity in a Thomas Splint, the fragments being in good alinement but after placement in a Russell Traction the position of the fragments changed considerably. At the end of fifteen days traction was removed and the patient was placed on a Hawley Table where another attempt at correction was made. This was unsuccessful because considerable soft callus prevented the coaptation of the ends of the bones. Skin traction and a plaster spica cast was then applied and maintained for six weeks. At the end of



a *b* *c* *d*

FIG. 7*a*, Case XII. P. I., eight years old, oblique fracture of middle of the femur; treated by plaster cast and continuous adhesive traction, October 10, 1930. *b*, November 2, 1930 fragments slipped within the plaster cast. *c*, September 15, 1934 beginning restoration of contour of femur. *d*, December 14, 1935, five years and two months after injury, no shortening or disability.

this period the fragments were found to be firmly united and the boy was discharged with only a 0.5 cm. shortening and no other impairment of function. We were unable to follow the case. The other child was five years old, with both limbs paralyzed from anterior poliomyelitis. The fractured extremity was placed in Russell Traction. At the end of seven days traction a plaster spica cast was applied so that the child could be transported. The cast was removed after eight weeks and surprisingly good union was found with no shortening.

REFRACTURES OF FEMUR

Refracture of the femur occurred in 2 cases treated by Russell Traction and in one that was treated by traction and plaster. In the case of F. H., eleven years old, treated by Russell Traction, the mother was instructed to keep the child in bed for a further two weeks, because on *x*-ray examination there was found to be one inch of overriding. We overestimated the fixation of these fragments because of exuberant callus; hospitalization for two to four weeks longer might have prevented this refracture. The second case R. R., treated by Russell Traction was a child seven and a half years of age who had a spina bifida with paraplegia. She sustained a spiral fracture of the mid third of the femur and was treated in Russell Traction for six weeks. Two days after the removal of Russell Traction she sustained a supracondylar fracture of the same femur while lying in the bed. The third case N. L. seven years old was treated in Russell Traction for two days when it was discovered that the child had an active gonorrhoeal vaginitis. She was placed in plaster and traction which was removed after six weeks time. While in a bath tub she refractured her femur and a plaster traction apparatus was reapplied. The detailed reports of these 3 cases of refracture follows:

Case 1. F. H., eleven years old, was admitted on October 4, 1932 with a history that fifty-four hours previously he fell from a truck in Port Jervis, N. Y. and a wheel passed over the mid-portion of the left thigh. At Port Jervis thirty pounds of traction was applied

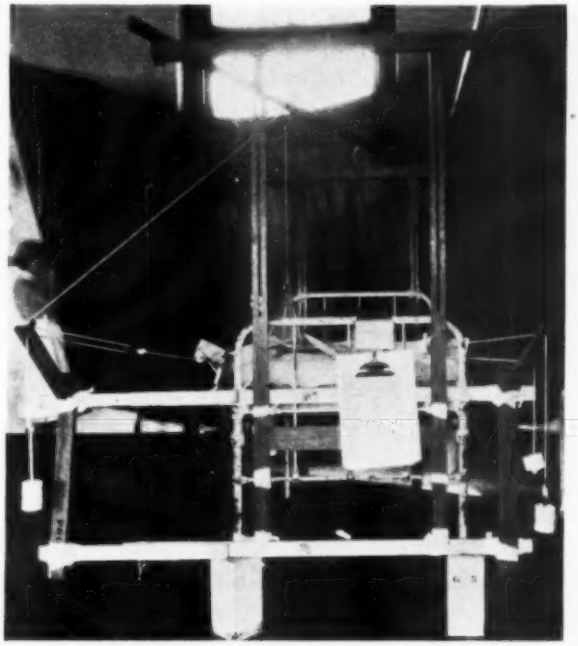


Fig. 8. Modified Russell Traction for fracture of the neck of the femur with both extremities in abduction and the fractured limb inverted.

and before removal to New York he was placed in spica plaster cast. At Bellevue Hospital radiographic examination revealed an oblique fracture of the midshaft of the femur with considerable overriding. The right leg measured 78.5 cm. and the left leg 77 cm. Russel Traction was applied with fifteen pounds weight for twenty-four hours and thereafter ten pounds was maintained. One week later the left leg measured 77 cm. and the right leg measured 78 cm. Subsequent *x*-ray films showed the lower fragment displaced posteriorly; three pounds weight was removed. On November 16, traction was discontinued. The callus appeared firm and there was no clinical deformity. The right leg measured 80.5 cm. and the left leg measured 79.5 cm. Twelve days later he was walking but with some difficulty. The patient was allowed to go home on December 7, and advised to remain in bed for two weeks longer. On December 22, 1932 the boy slipped and fell refracturing this femur. He returned to the hospital and Russell Traction was reapplied. His course thereafter was uneventful and traction was removed on January 31, 1933. At that time the right leg measured 80.5 cm. and

the left leg measured 80 cm. On February 26, 1933 he was allowed home with a walking caliper. The left thigh presented slight atrophy of the muscles but union was firm. One year later there was no residual changes in the muscles and the femur had assumed its normal contour without shortening.

Case II. R. R., seven and one-half years old, was admitted on June 15, 1933 with the history that while playing on the floor he rolled over and fractured his left femur. This child had been born with a lumbar myelomeningocele complicated with complete paraplegia below the waist, accounting for the fact that the child had no discomfort. There was slight swelling at the middle third of the right femur with a definite point of false motion. The right leg measured 64 and the left leg 63 cm. in length. Both legs were spastic. Radiographic examination revealed a spiral fracture in fairly good position involving the middle third of the right femur. Russell Traction was applied with six pounds of weight. The clinical course was uneventful and on August 7, 1933 traction was removed. Callus was extensive and union was firm. Two days later the child again fractured the left femur apparently by muscular contracture. On *x*-ray examination a transverse supracondylar fracture was found below the site of the previous fracture without displacement of the fragments. Russell Traction was reapplied for another six weeks. On October 4, 1933 the patient was discharged with good union of both fractures with only 1 cm. of shortening. Because of the difficulty in transporting the child she has failed to return to the clinic. Home visit by our social service reports no impediment resulting from the fracture; her disability being due to the paraplegia.

Case III. N. L., seven years old fell down a flight of stairs just before admission to Bellevue Hospital on November 28, 1930. While falling she twisted her right leg under her. A Russell Traction with twelve pounds weight was applied. Before suspension was applied the right leg measured 60.5 and the left leg measured 61 cm. in length. Radiographic examination revealed a fracture of the middle third of the right femur with forward displacement of the upper fragment with slight overriding of the fragments. On the second day Russell Traction was removed because the patient was suffering from gonorrheal vaginitis. She was placed in Burdick-Siris traction and was removed from the Children's Surgical Ward. On December 31, 1930 *x*-ray examination showed some backward displacement of upper fragment with overriding. On January 9, 1931 the cast was removed. The child was given a bath in a tub at which time the femur was refractured. The Burdick-Siris traction was reapplied. The course thereafter was uneventful. On March 8, 1931 the cast was removed. On March 19, 1931 the patient was discharged with moderate callus about the fracture with 45° flexion of knee. The right leg measured 63 and the left leg measured 62.5 cm. The follow-up on May 16, 1933 revealed both lower extremities measuring 71 cm. with no impairment of function and there was restoration of the contour of the femur to normal.

In reality only one case of refracture of the femur can be stated as having occurred after treatment with Russell Traction, namely, Case I. This refracture we attribute to an excessive amount of weight being used in traction which caused a wide separation of the fragments necessitating the formation of an abundant amount of callus, the strength of this being overestimated. It has been definitely established that too much weight will not correct overriding but will cause a spasm of the muscles and distortion of the lower fragments.[2]

RESULTS OF TREATMENT OF FRACTURES OF BOTH FEMURS BY RUSSELL TRACTION

Three children sustained fractures of both femurs and on admission were treated by Russell Traction applied to both extremities. No difficulty was encountered with this procedure and nursing care was made easier. The anatomical and functional results were excellent.

ANALYSIS OF CASES WITH FRACTURES OF BOTH FEMURS

Case IV. S. T., six years old, was admitted on September 9, 1933 with the history of being struck by an automobile and knocked unconscious. He complained of pain in both thighs and the left side of the head. The right thigh showed anterior bowing at the junction of the middle and lower third with crepitus

on attempted motion. The left thigh showed slight anterior bowing over the middle third of the femur. Radiographic examination revealed a spiral fracture of the middle third of the left femur with the fragments in good position and a fracture of the lower third of the right femur with backward displacement of the distal fragment with some overriding. Russell Traction was applied to each leg. At the time of admission the right leg measured 57 cm. and the left leg measured 58 cm. The traction was discontinued on September 13, 1933 at which time the formation of an exuberant amount of callus was shown to be present at the site of both fractures with firm union. On November 8, 1933 ninety days after admission he was discharged from the hospital. He had been up and around the ward for two weeks without impairment of motion. At this time the right leg measured 60 and the left leg 59.5 cm. On December 7, 1935 two years and four months after the injury, both femurs were of equal lengths, the shafts of the femurs had assumed their normal contours, and there was no impairment of function.

Case v. S. McG., nine years old, was admitted on March 18, 1932 two hours after jumping from a truck at which time a rear wheel had passed over both thighs. Radiographic examination showed a transverse fracture at the middle third of both femurs with outward and forward displacement of both upper fragments with overriding. The lower extremities measured 69 cm. Both limbs were placed in Russell Traction. On the forty-second day an exuberant amount of callus was present and therefore the traction was removed. For the first ten days out of traction both knees were moderately resistent to motion. On May 28, 1932 the patient was discharged with no shortening, firm union and no impairment of motion. He was followed until May 11, 1935, three years and two months after the accident. At that time both lower extremities measured 77 cm. There was no deformity, disability or impairment of function.

Case vi. E. S., six years old, was admitted on September 11, 1934 with the history of having been struck by an automobile and knocked unconscious. She complained of pain in both thighs and left arm. The left leg measured 54 and the right 59 cm. *X*-ray examination revealed a fracture of the left humerus and fractures through the middle of both femurs, with the comminuted and impacted ends of the right femur. The left femur was fractured transversely with 2 inches overriding. Both thighs were placed in Russell Traction. Some overriding of the fragments of the left femur persisted. On October 13, 1934 the callus was exuberant, union was firm and so the traction was discontinued. The right leg measured 60 cm. and the left leg measured 59 cm. On October 30, 1934 the patient was allowed in a wheel chair and on November 5, she began to walk. On November 8 she was taken to Willard Parker Hospital with scarlet fever. She returned at intervals to our clinic. Radiographic examination on December 7, 1935 revealed firm union, the right femur showed no traces of any previous fracture, the left femur was firmly united and the shaft was assuming its normal contour. Both extremities measured 61 cm. The function was perfect and there was no disability.

Results of Treatment of Fractures of Neck of Femur

During the past fifteen years there have been 10 cases of fracture of the neck of the femur admitted to the Children's Surgical Service. Six have been reported by Colonna.[3] Three of these were of the incomplete cervicotrochanteric type and in one case the fracture occurred through the narrowest portion of the neck. This study includes 4 cases, 2 of which were treated by the Whitman Method and 2 by the method of Russell Traction in abduction and internal rotation as illustrated in Figure 9. One of these patients had a subcapital fracture which was in fact an epiphyseal separation of the head and the other 3 were of the transcervical type.

Case Reports of Fractures of Neck of Femur

Case vii. A. P., seven years old, was admitted to Bellevue Hospital on July 3, 1933 soon after being run over by an automobile, with an extensive laceration of the perineum, vagina and right groin. She sustained a fracture of the neck of the left femur in the transcervical region and a comminuted fracture of the pelvis with separation of the sacroiliac joint. She was transfused and a plaster spica cast with a large

window for access to the wounds was applied. The wounds became infected and a low grade osteomyelitis developed, which subsided in three months. The patient was discharged from the hospital on March 20, 1934 at which time the anterior superior spine on the left side was tilted upward about 4 cm. higher than the right and there was 2 cm. shortening of the left lower extremity. Radiographic examination revealed marked rarifaction of the head and neck of the left femur. She was last seen in the clinic on December 7, 1935, two and a half years after her injury. She walked spryly with a raised wooden heel. The right hip was everted 30° and abducted 20°. The left lower extremity measured 59.5 and the right 61 cm. The head and neck of the femur were shrunken and partially absorbed and firmly ankylosed to the acetabulum. There was 2.5 cm. shortening.

Case VIII. M. W., was eight years old when she was struck by an automobile on September 23, 1933 about an hour before admission to the hospital. Examination revealed a fracture of the upper third of the left humerus, a fracture of the left clavicle and a transcervical fracture of the neck of the right femur. There was 40 per cent displacement of the head of the femur in an inward and downward direction. The fracture of the femur was not detected until two weeks after the injury at which time it was thought inadvisable to disturb the impaction. An anesthetic was administered and the right femur placed in position of abduction and inward rotation in a Whitman's cast with no attempt to correct the position of the fragments. On removal of the plaster cast two months later there was 2 cm. shortening. She was allowed out of bed two weeks later and discharged January 8, 1934 with 45° flexion of the knee and 2 cm. shortening of the right leg. She returned to the clinic at intervals and was last seen on December 7, 1935 at which time there was perfect function with no limping or shortening of the right lower extremity. This fracture with 40 per cent displacement was not reduced but the neck and shaft reunited firmly with 2 cm. shortening of the leg and widening of the neck with a coxa vara deformity. Two years and two months after injury there was no impairment of motion in any direction, no pain or limp or shortening.

Case IX. S. W., was eleven years old when she was admitted on October 18, 1931 with a history of pain and inability to use the right hip for two weeks. Fourteen days previously she had fallen, after which she was able to walk with difficulty. On admission there was no definite tenderness, pain or ecchymosis over the right hip. The thigh was semiflexed with external rotation of the leg. The left leg measured 85.6 and the right 83 cm. Radiographic examination revealed a subcapital fracture, truly a separation of the epiphysis with outward rotation of the shaft of the femur. Sixty per cent of the head was in proximity with the neck. Both lower extremities were placed in a Russell Traction in marked abduction with internal rotation of the right leg. On October 23, 1931 the *x*-ray examination revealed 90 per cent reduction. On January 8, 1932 the traction was discontinued. Radiographic examination showed the head and neck in good alinement with some internal rotation. The *x*-ray examination on March 3, 1932 revealed the acetabulum considerably enlarged and eroded. Epiphyseolysis of the right hip was evident. The epiphysis of the head of the femur was somewhat smaller than that on the left side. The neck of the femur showed several small areas of bone atrophy but firm bony union. She was discharged from the hospital on March 17, 1932 approximately five months since the injury with complete abduction and rotation of the hip. The right leg measured 84 and the left 85 cm. She began to walk one month later at which time there was 1 cm. shortening. Five months later there was some limp present but abduction, adduction and rotation was complete and there was only 0.5 cm. of shortening. She returned to the clinic at frequent intervals. On December 7, 1935, four years and two months after the fracture was sustained, both lower extremities measured 94 cm., there was no limitation of abduction, adduction, rotation or flexion of the hip joint. The radiographic examination at this time revealed some shortening and thickening of the neck of the right femur. The functional result obtained in this case by the treatment with Russell Traction was excellent, the reduction was satisfactory, the nursing care was simplified and a considerable range of activity of the musculature of the thigh was obtained.

Case X. F. D., seven years old, fell from a first story window on July 10, 1935 and sustained a transcervical fracture of the neck of the femur. The extremity was suspended in Russell Traction with abduction and internal rotation and four pounds traction. The traction

was discontinued on September 10 and he was allowed to go home on September 27, 1935 with no shortening. He was instructed to remain in bed for another month. On January 4, 1936 there was no shortening of the extremity or limitation in range of motion of the hip. Radiographic examination showed evidence of union and no shortening of the neck. This case has been followed too short a time to warrant any definite conclusion. However our experience in the previous cases and the present status of the neck of his femur justifies our expectation of an uninterrupted perfect functional recovery.

The course of events in the 3 simple fractures of the neck of the femur in this series is a little at variance with those observed in the usual case of an adult. The circulation of blood through the ligamentum teres and the endosteal vessels from the major fragment was not impaired sufficiently to produce necrosis, absorption of the head and neck or non-union. On the contrary, there resulted an increased density of the osseous structure of the neck with adequate fixation. On discharge from the hospital 2 cases of simple fractures presented shortening and widening of the neck of the femur and one developed a coxa vara deformity. At the time that the last examinations were made of these 3 patients, six, twenty-six and fifty-six months respectively after each of their injuries, there was no shortening, pain, limp or impairment of mobility of the hip-joint in any of these.

The Russell Method of traction with the limbs in abduction and internal rotation is recommended for treatment of fractures of the neck of the femur. In Figure 4 Case VIII, both legs are illustrated in abduction and internal rotation. The fragments become welded into position and complete physiological rest is obtained while traction in the direction of the bony axis of the femur is exerted. As union progresses active motion of the extremity is permitted and the nursing problem is simplified. The simplicity and effectiveness in realining the fragments and the excellent functional results that are obtained justifies the recommendation of this procedure in fractures of the neck of the femur.

SUMMARY

One hundred and nineteen children with fractures of the femur have been treated on the Children's Surgical Service of Bellevue Hospital from January 1, 1930 to December 31, 1935; 30 of these by the Modified Bryant's Overhead Suspension, 15 by reduction on a Hawley Table and the application of a continuous adhesive skin traction and a plaster spica cast and 72 by Russell's Method of traction and suspension.

The procedures which gave uniformly good results in the 268 cases of fractures of the femur reported by Burdick and Siris in 1923 have been followed in this series with the exception that Russell's method of suspension has been added and has been found so satisfactory that it has gradually supplanted the cast and traction methods.

In the case of infants and children under four years of age, the Modified Bryant's Overhead Pulley Suspension with sufficient weight to keep the buttocks uninterruptedly off the mattress, is recommended.

The Russell Method of traction has been routinely adopted on the service for children older than four years of age for the following reasons; it is simple in its application and management; it is effectual in alining the fragments and it entails few nursing problems. The method permits early active motion and results in an exuberant amount of callus and complete restoration of function.

The incidence of satisfactory apposition of the fragments was higher with Russell Traction than with other methods that we have used. This in part can be attributed to the obligatory application of the Thomas splint to the injured limb by the ambulance surgeon before transporting the patient to the hospital from the site of accident.

There was no residual shortening in 109 of the 115 cases of fractures of the shaft of the femur. Three children in this group of 119 cases could not be traced.

The others were followed from three months to six years.

There was only one case in this series of separation of the upper epiphysis and none of the lower. One case of separation of the lower epiphysis occurred in our previous group. The separation of the upper epiphysis was effectually reduced by Russell Traction with the limb in abduction and internal rotation.

Fractures of the neck of the femur in children can be effectively reduced and treated with comfort in Modified Russell Traction the limb being held in abduction and internal rotation.

In this series of fractures of the shaft and neck of the femur there was no case of non-union.

When the anatomical approximation of the fragments of bone was absent the normal continuity and contour of the shaft of the femur became re-established within two to three years.

Open operation was not indicated in any case of this series and is rarely justified in children unless some mechanical interposition prevents union after prolonged immobilization.

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* *Continued from p. 229.*

ETIOLOGY OF CHOLELITHIASIS

EXPERIMENTS OF THE AUTHOR

H. A. PETERSEN, M.D., F.A.C.S.

Visiting Surgeon, St. Joseph's Infirmary, Memorial and Methodist Hospitals

HOUSTON, TEXAS

IT is indeed remarkable that a disease so well understood in all its clinical manifestation and rendered practically certain of diagnosis through the comparatively recent studies of Graham and Cole, should be so obscure as regards etiology.

It is not my purpose to discuss the clinical manifestations nor the diagnosis and treatment of gallstone disease. In cholelithiasis, as in nearly every disease to which man is subject, our knowledge of its shaded clinical variety and, to no small degree its treatment has far outrun our knowledge of causation. A review of the progress made thus far is offered, clarifying our notions of gallstone etiology with a brief report of some experiments.

Two schools of thought regarding gallstone formation have arisen, namely, those who hold to the infectious origin of the disease and those who believe the underlying process to be a colloidal chemical phenomenon.

Modern knowledge of cholelithiasis began with Von Helmbach during the middle of the last century. His observations appeared under the caption, Microgeologie, published in 1856, in which he called attention to the analogy between calculi as found in man, and pearl and shell formation as found in the mollusk. Pearl formation usually began with an organic scaffolding, perhaps the result of inflammation to which inorganic salts adhered, with the resultant petrification of the base structure.

Preceded in 1856 by Mickel Von Helmbach who merely suggested it, Galippe, as early as 1886, advanced the theory of a microbic origin, yet the major credit for the demonstration of the infectious nature of cholelithiasis rightly belongs to Gilbert. His observations made in 1890 were utilized later by Naunyn at the Wiesbaden Congress in 1891, when Naunyn elaborated Gilbert's conception that stones are formed by the precipitation of substances normally contained in the bile, especially cholesterin, bilirubin and lime, and that such precipitation depended primarily upon biliary infection.

The decade following the Wiesbaden Congress, 1890 to 1900, was marked by the appearance of many investigators bent upon the experimental production of gallstones. Notably among them were Gilbert and his collaborators Girode, Dominici, Claude and Fournier; Mignot, Shade, Aschoff, Bacmeister, Exner and, in this country, Cushing, Richardson and Hunner. The experimental attempts of these workers to produce calculi of infectious origin were fraught with many difficulties and for a long time remained unavailing. In 1893 Gilbert and his workers noted the presence of "petites concretions verdatres," small green concretions which had formed during a typhoidal cholecystitis in a rabbit. Following this observation methodical, painstaking efforts were made over a period of years to obtain more perfect, undoubted concretions. In January, 1897, these efforts were rewarded by the formation of a definite stone obtained from the gall bladder of a dog previously innoculated with Bacillus coli communis. Gilbert and Fournier, however, failed to make known the results of their experiments until after Mignot, in May, 1897, had presented to the Societe de Chirurgie three small experimental stones formed in the gall bladder of a guinea pig, the colon bacillus having been used as the infective agent in the gall bladder. Mignot, after these careful and successful experiments, concluded that the

chief factors in the production of biliary lithiasis are: (1) the presence in the gall bladder of an attenuated organism of any variety; (2) a relative inertia of the biliary reservoir causing partial stasis and preventing the expulsion of soft concretions of cholesterin.

Gilbert and Fournier, stimulated by Mignot's idea of attenuation, succeeded in the production of biliary calculi in a rabbit, resultant from an infection with Bacillus typhosus. Gilbert however sounded a warning against the unreserved interpretation of human lithiasis in the same terms, since he was able also to produce lithiasis by chemical irritation of the vesical wall in the absence of infection. These calculi were regarded as stones in the primary stage of their development and were not unlike those produced in this country at a later date by Richardson and Cushing, as a result of gall-bladder infection by the same organism, Bacillus typhosus. The agglutination of Bacillus typhosus in bile was at that time commonly known, and most observers believed that it was this special property of bile, which in vivo caused agglutination of the Bacillus typhosus organisms, causing the formation of a nidus, or framework upon which the superstructures of stones could be added. This was Richardson's hypothesis, and using this principle he innoculated a previously agglutinated culture of Bacillus typhosus directly into the gall bladder of a rabbit. Many experiments in which this procedure was followed were conducted, and success in producing calculi obtained in only one instance. The presence of such groups of bacteria (a nidus) alone seems insufficient, since Richardson found in 5 out of 6 fatal cases, large clumps of organisms present without any evidence of stone formation. Hunner proceeded with experiments based upon the same principle as Richardson and Cushing, with no greater measure of success.

The foregoing resume touches only the outstanding efforts made to produce gallstones through the introduction of infecting organisms into the gall bladder. The organisms used were either Bacillus coli communis or Bacillus typhosus.

Of those workers in the field who tenaciously held to the colloidal chemical view as to the etiology, Aschoff was perhaps the first and foremost. Aschoff, a contemporary of Naunyn, could not subscribe entirely to the theory of stasis and infection, since he observed repeatedly that cholesterin stone formation recurred even in sterile bile. Further, from histological studies he found no evidence of inflammation, past or present, in the gall bladders containing cholesterin stones; whereas in those gall bladders containing stones of the other variety, (stratified, radiating) evidence of inflammation was always present. These views of Aschoff, which were written in 1891, have stood the test of time. It is common knowledge and an observation made constantly in the operating room, that in gall bladders containing cholesterin, the so called mulberry stones, there is no gross or microscopic evidence of present or past inflammation. Further, Aschoff differed with Naunyn as to the source of the cholesterin frequently observed in the gall-bladder epithelium, a very fundamental point in the production of cholesterin stones. Naunyn believed that the cholesterin so observed was a product of the gall-bladder epithelium, since these cells contained it in greater amounts than the liver cells. Aschoff regarded its greater abundance in the gall-bladder epithelium as an expression of absorption, the latter phenomenon being encouraged by such agencies as stasis due to mechanical factors, for example, pregnancy. This idea was supported in a measure by the experimental observations of Harley and Barratt, and likewise those of Hansemann, who introduced cholesterin stones from man into dogs, and noted a gradual dissolution with absorption, rather than an increase through added increment from the gall-bladder epithelium.

The development of the colloidal chemical viewpoint of gallstone etiology has

presented an interesting attack upon a very difficult problem. There can be little doubt that infection plays a vital role, except in the cholesterin stone, yet infection alone probably does not explain the process in its entirety. The colloidal theory presupposes colloidal precipitates, such as fibrin and other proteins, serum albumin and globulin, which appear in the bile as a result of inflammatory processes. With these colloids, crystalloids are brought down, which result in the stratification so frequently seen, of which the bilirubin lime calculus is the end result.

Foremost among the workers in the colloidal chemical approach to the problem have been Aschoff, Shade, Bacmeister, Exner and Heyrowsky.

Bacmeister concluded from his investigations that if bile were kept under sterile conditions for long periods, cholesterin precipitation occurred but believed that some essential change in the bile must take place first. He noted also that if gall-bladder epithelium were added the process was hastened very materially. This he attributed to the combination of the positively charged protein, with the negatively charged cholesterin particles, which resulted in precipitation. The colloidal chemical conditions involved are still matters of controversy, yet his results are vitally important, since in his observations infection played no role.

Entering into the controversy, Shade assumes the phenomenon happens only when the solvent action of the bile in cholesterin is altered, as for example, if the cholate disappears in stasis. Exner and Heyrowsky have actually demonstrated that this occurs in the autolysis of stagnant bile. They also find less cholate than normal in bile from fistulas of gallstone patients. Thus we see that though infection has been removed from consideration through the conditions of their experiments, stasis with resultant changes in the bile, have entered. These changes produced through stasis, namely a reduction in the solvent action of the bile and a disappearance of cholate, offer problems the explanation and solution of which have not as yet been forthcoming.

Many have held that the formation of cholesterin stones has been the direct result of a cholesterolemia. In diseases such as diabetes, pregnancy, and occasionally arteriosclerosis, there is an increase in the cholesterin content of the blood and bile. It would seem almost incredible from a theoretical colloid chemical viewpoint, that unless such an increase be very great, no precipitation of cholesterin would occur. On the other hand, Chalatoff obtained precipitation experimentally in the gall bladders of rabbits by cholesterin feeding.

Rous, McMaster and Drury of the Rockefeller Institute, recently have taken up the problem attacking the question of cholelithiasis in an extremely careful manner. In their studies they have attempted to exclude the factors of stasis, infection and gall-bladder activity, to show that gallstone formation could take place in the absence of these. Infection and activity of the gall bladder were definitely excluded by the conditions of their experiments; but it seems doubtful if under any given conditions requiring collection through 25 or 30 cm. of tubing, that statis could be excluded. This becomes more problematical since the diameter of the tubing is greater than that of the common or hepatic ducts, and where the stream bed is wider the current is more stagnant. However, these workers have carried the problem further than their predecessors, their results leading them to conclude that in the intubated dog there are present certain sedimentations, which they term nuclei. These are described microscopically, as highly refractile spheres composed of an organic scaffolding of elastic mucous, with calcium carbonate and calcium bilirubinate deposited within the nucleus. They believed these nuclei of deposition to be showered into the bile stream as a result of liver damage, and to demonstrate their point, produced liver injury with toluendiamin and chloroform anesthesia. These experiments proved that as a result of liver

damage such nuclei are showered into the biliary stream. In working with human bile, though rather limited, nuclei were found only in 4 patients who had stones and a chronic mild inflammation of the gall bladder. The presence of nuclei within gallstones has been rather generally observed since Charcot, Naunyn and Lichtwitz stressed their importance in the early 1890's. With Lichtwitz, one still raises the question as to whether the nuclei are the result of an inflammatory process. The studies of Rous, McMaster and Drury, "Stone Building from Nuclei" have been most comprehensive and gratifying, yet of even greater significance may be their studies, "On the Relation of the Reaction of the Bile to Experimental Cholelithiasis."

The interesting observation was made that, in a large proportion of instances, bile from the gall bladder was frankly acid to litmus; whereas liver bile, derived from the hepatic duct, was nearly always somewhat alkaline, and usually markedly so. Using a potentiometer they found that at 37°c. liver bile was regularly alkaline, *p*H. 7.07 to 8.55. During fasting, they found the bile was less alkaline. Gall-bladder specimens obtained a few hours after eating were either neutral to litmus, or alkaline; whereas those procured after a fasting period of forty-eight hours, were usually markedly acid to litmus.

These observations were at first presumed to be original with Rous and his co-workers, but a review of the literature reveals they were preceeded in 1915 by Okada, who made similar observations, and in 1921 by like determinations of Nielson and Meyer.

Okada, using the dog and electrometric methods, found that gall-bladder bile ranged from *p*H 5.43 to 6.97 in the fasting animal, whereas liver bile procured through a fistula was always alkaline with a range in *p*H of 7.54 to 8.15, fasting having no influence upon the biles obtained from hepatic duct.

Nielson and Meyer using colorimetric methods and rabbits corroborated the work of Okada. They showed further, that base forming diets definitely increase the average titrable alkalinity of the bile, whence they inferred that the alkalinity was due to the presence of carbonates.

The explanation of this change in the bile within the gall bladder is not understood. Conceivably, it may be the result of chemical changes occurring in a labile secretion as a result of its prolonged retention at body heat, or, on the other hand, of some influence exerted by the organ of retention. The latter seems the more likely, since liver bile, which is alkaline, when collected in a balloon, as done by Rous, and kept warm remains highly alkaline. Nielson and Meyer also observed that in gall bladders, so injured by infection to lose this function, the *p*H of the bile remains that of the secretion as derived from the liver.

If the bile in the gall bladder is normally acid, as these observers maintain, one must regard this as a protective mechanish against the formation of the ordinary calcium bilirubinate stone, the variety found most often in association with cholecystitis. However, if the gall bladder has been so injured by infection as to lose this function,* of changing an alkaline hepatic bile to an acid reaction, one may believe that gallstones might form, or rather that such a media might be conducive to gallstone formation. On the other hand, an acid media would be favorable for the production of the cholesterin stone, the so called mulberry stone, since colloids are precipitated in an acid media.

Previous to these reports, Dr. Robt. T. Miller and I, in sixteen experimental animals, anastomosed the lower end of ileum to the gall bladder, producing a severe cholecystitis and a perihepatitis of marked degree, not unlike the condition so commonly found in patients with a severe

* Note. Until further studies are made, it is doubtful whether this change should be considered as a function of the gall bladder. When the particular point in question is clarified, then one can say whether the change from an alkaline hepatic bile to an acid gall-bladder bile has been occasioned through gall-bladder function or through an inherent change in the bile itself.

cholecystitis. In half of these, the anastomosis was freed later so as to simulate more closely the cholecystitis as found in man. After a period of several months, these animals were sacrificed, and in no instance was there a stone. Several animals showed many small concretions (petites concretions vedatres as described by the earlier workers, or the pepper granules of the more recent experimenters) but not a single bonafide stone. Discouraged by our failures to produce gallstones by infecting the gall bladder, an effort was made to determine whether or not gallstones could be produced experimentally, by changes in the hydrogen ion concentration in the bile. These experiments were begun in the Hunterian Laboratory at Baltimore, using eight to twelve dogs.

Method. In order to obtain a constantly acid bile, several attempts which were made fixing the gall bladder to the anterior abdominal wall and injecting weak acid directly into the fixed gall bladder, were unsatisfactory. A graft from the acid bearing portion of the stomach was transferred directly into the gall bladder without leaving an opening between the stomach and the gall bladder, at the same time leaving intact its blood supply contiguous with the stomach. In the beginning, some difficulty was experienced in avoiding tension and its concomitant necrosis of flap, since the transfer of such a flap necessitated almost a 180° twist of its pedicled base. Tension was avoided by making the flap a little nearer to the pylorus, at the sametime partially mobilizing the gall bladder. In later experiments the latter procedure was found to be unnecessary.

In order to secure alkaline biles, it was thought that similar pedicled flaps might be taken from the duodenum. This was tried, but here the duodenal lumen was so constricted that sharp kinking and obstruction followed, if a sufficiently large graft was taken. Therefore about 8 cm. of duodenum was isolated, both ends invaginated, and an anastomosis, fundus of gall bladder to side of isolated loop, was performed. The continuity of the duodenum was then reestablished either by end to end, or side to side anastomosis, whichever method could be most readily done.

The following proctocols of one animal in each group, are given in detail, describing the method of experiment.

Experiment No. 8. Dog No. 8.

Morphia gr. $\frac{1}{6}$ hypo. was given twenty-five minutes before operation, which was done under ether anesthesia, requiring one hour for a transplantation of a flap from the acid bearing portion of the stomach to the gall bladder.

The abdomen was opened through a high right rectus incision. The stomach and gall bladder were exposed; no abnormality was present that would render the operation difficult. A site for the graft was chosen from the lesser curvature of the pyloric antrum of the stomach, which had a good blood supply; that is, containing a transverse branch of the coronary artery. An elliptical incision was made through all the coats of the stomach to a point opposite the origin of the blood vessel from the coronary artery, this being left intact as a base for the pedicle flap. The mucosa was divided across the base of the pedicle down to the submucosa. The opening, thus made in the stomach, was closed with a continuous suture of silk, reinforced with interrupted Lembert sutures of silk.

A linear incision was then made in the gall bladder and the graft sutured in situ with continuous silk, reinforced at the base with Lembert sutures of silk. The abdomen was then closed.

Experiment No. 9. Dog No. 9.

Morphia gr. $\frac{1}{6}$ hypodermically was given one-half hour preoperatively. Isolation of loop of duodenum, lateral anastomosis of duodenum to ileum to secure continuity, and lateral anastomosis of the gall bladder to isolated loop, was done under ether anesthesia, requiring eighty-three minutes for the procedure. A high right rectus incision about 8 cm. in length was carried through skin, subcutaneous tissue to the rectus sheath, which was divided and the muscle separated by blunt dissection. The peritoneum was picked up and incised. The duodenum was brought into view, and a portion of the proximal third below the ampulla was isolated, and both ends were then

invaginated. Reestablishment of continuity was accomplished by lateral anastomosis. The isolated loop was washed, and lateral anastomosis made with the gall bladder. Closure was effected in the usual manner.

Fig. 1. Fig. 2.

Fig. 1. Site from which graft is taken, and blood supply to graft.

Fig. 2. Duodenal isolated loop anastomosed to gall bladder.

After a period of three to six months these animals were sacrificed, and the following observations were made:

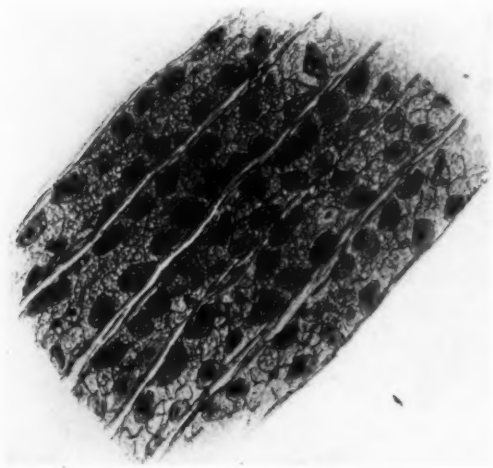

Fig. 3. Microscopic section of transplant.

The bile obtained from the gall bladder containing the duodenal transplants was alkaline to litmus. The bile in these animals was more viscid than normal, and in two instances was extremely dark and thick, resembling what is sometimes called when encountered in the human, "gall-bladder mud." There was no evidence of any stone formation.

The group which had the gastric transplant were far more interesting. The biles of these animals were definitely acid to litmus, and potentiometer readings by Dr. Emmett Holt on all except the recent experiments gave *p*H values varying between 6.4 to 6.8. None were as low as 5.4 recorded by Okada. The biles were thin and

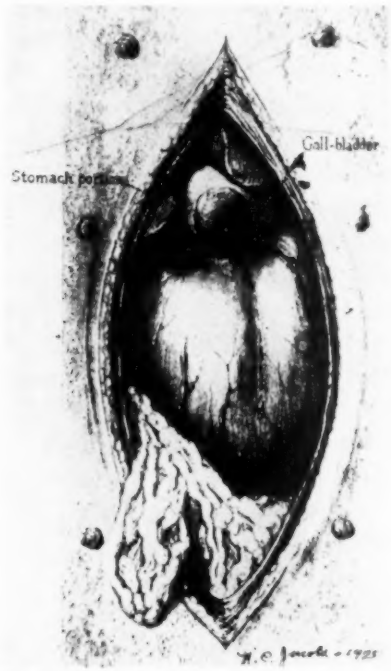

Fig. 4. Pedicle graft of stomach implanted into gall bladder.

light colored and no stones were found; but the gall bladders resembled very strikingly the so-called "strawberry gall bladder," which I take them to represent. Grossly, the gall-bladder wall appeared reddened and congested with colesterin particles scattered over the entire surface. Some of this cholesterin could be washed off with gentle irrigation, indicating it to be free. A portion, however, could not be removed and was definitely either being

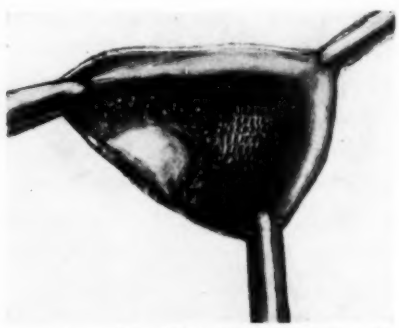

Fig. 5. A portion of gall-bladder wall showing gastric implant from within. Small cholesterin particles may be seen on surface of gall-bladder epithelium.

absorbed or secreted by the gall-bladder epithelium.

I am not able to determine whether this observation is one of secretion or absorption. However, I believe with Aschoff, as mentioned previously, the process to be one of absorption; that cholesterin has been precipitated in the presence of acid, and absorption is taking place. In several animals, where the knot of silk had been tied inside, the silk was working its way into the vesical and definite concretions of cholesterin were invariably around these. Sections taken from the gall bladder showed no evidence of infection, and those taken from the graft show the stomach mucosa to be perfectly normal.

There was no evidence of ulceration of the stomach mucosa transplanted into the gall bladder. This observation is beside the problem at hand, but is interesting in the light that it is sometimes stated, that the presence of bile in the pyloric antrum may be a factor in the production of gastric ulcer.

Detailed drawings show the method employed in the dogs bearing gastric implants in the gall bladder. This shows, with clarity, the site from which the graft was taken from the stomach and its implantation in the gall bladder. Figure 4, made at the time of autopsy three months after operation, shows how the graft has fared in its foreign environment with no apparent change.

Figure 5 shows perhaps better than description the appearance of the gall-bladder mucosa in these animals.

CONCLUSIONS

In these experiments, the actual production of gallstones cannot be regarded as having had any greater degree of success than that which gratified the number of workers who have previously attempted to produce them.

However, a condition has been produced in the experimental animal which may be regarded to be, what we clinically term a forerunner of gall stones, namely, the "strawberry gall bladder." Further it has been demonstrated that a gastric graft, when transplanted to the wall of the gall bladder, lives, and in so far as we are able to determine by electrometric determination of bile *p*H and microscopic appearance, continues to function.

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CONTRIBUTING FACTORS OF PERITONEAL INFECTION IN CLOSED INCISIONS OF ABDOMEN

R. M. HARBIN, M.D., F.A.C.S.

Senior Surgeon, Harbin Hospital

ROME, GEORGIA

WHILE absolute asepsis is impossible a standardized aseptic technic seems to meet the needs of operative procedure in the great majority of cases. However, a certain number of cases with the same standard applied may be followed by unexpected infections and we are led to wonder what part in the process is played by the well nigh omnipresent so-called non-pathogenic bacteria. Spores of bacteria have been taken from the subzero temperature of the stratosphere and bacteria may be found in the buried ruins of Egypt. We know that various strains of certain bacteria show different degrees of virulence because of environmental influences and we have reason to believe that non-pathogenic bacteria under certain circumstances exhibit the same phenomena even becoming pathogenic, for the diphtheroids alone have been found at autopsy in endocarditis. In many pathological conditions these low grade bacteria seem to invite the presence of well known organisms. While scientific proof is lacking, clinical observation rationalizes such a theory which would explain hematogenous infections generally. Showing transmutation of types of organisms, Green of the University of Minnesota, has observed a retrograde evolution of bacteria into a parasitic growth in the cause of poliomyelitis.

Any active infections developing within the first three days of convalescence would indicate a break of the standard aseptic technic while unexpected low grade infections have slower beginnings usually unrecognized in which non-pathogenic bacteria play the initial part.

Robert et al.[1] have made some interesting research studies of the intraperitoneal low grade bacteria that harmonize with clinical observations. They showed 80 per cent of positive cultures, diphtheroids more commonly, from the normal peritoneum and smears from the surface of a diseased organ gave no greater degree of positive cultures than remote areas of the peritoneum. The same observation was made in diseased conditions. They also showed a similar degree of positive cultures from the knife, skin and air in the operating room. These studies indicated a constant flux of serum and it is probable that every case would show positive cultures at some time or other. In the more advanced conditions of inflammation these bacteria disappear with an increase of the Bacillus coli but in a later stage redevelop with all the evils of symbiosis. So there seems to be a low degree of infectivity in every abdominal section but under favorable circumstances it is usually whipped by the conservative processes of the peritoneum, for there is an increased effusion of serum after every abdominal section, primarily provoked by trauma, which acts as a challenge to infection. Any increase of virulence is attended by a corresponding degree of effusion and by means of diffusion brings about an attenuation which makes for resorption. Similar processes take place in pleurisy. Under normal conditions it would seem that the cycle of effusion and resorption is kept activated by low grade organisms and like other functions become accelerated in the presence of surgical trauma, shock and infection in general.

Therefore, it is easy to understand how such processes can be overtaxed in closed incisions where resorption is hindered by damaged peritoneal coats in the presence of tympany with a vitiated effusion. It is

also easy to understand how these conservative processes become handicapped in the resorption of infected effusions hindered by a closed incision that might otherwise be alleviated by a simple tissue tube drainage partly relieving intra-abdominal pressure. Low grade infections in peritoneal effusions that cannot be absorbed are a menace and theoretically considered, tissue tube drainage would be effective, while in the presence of exudative peritonitis the area drained would be restricted because of adhesions. This theory helps to explain the development of adhesions primarily through a process of incubation which finally becomes evident in seven to ten days and may cause either early ileus or late adhesions that ultimately provoke symptoms of chronic obstruction. It occasionally may be noted that adhesions become more extensive and serious following apparently normal convalescence than result from grave types of peritonitis. The remarkable absorbing processes of the peritoneum may be observed in the spontaneous disappearance of organized adhesions especially following subacute infections.

We have observed that these adhesions develop after leaving a quantity of normal saline solution in the peritoneal cavity, while the bovine amniotic fluid concentrate, amfetin, has seemed to have favorable results covering a period of six years, and it is our opinion that this serum shows more than coincidental value. The therapeutic value of amfetin has been advocated for promoting the biologically isotonic quality of peritoneal effusions for resorption, the normal means for eliminating the products of low grade infections. This biological quality seems to concern the fibrin content of effusions in serous cavities generally. Hence, stagnated effusions invite gross infections that may result secondarily in general sepsis or abscess formation.

The assumption is reasonable that the thickness of the peritoneum is an index to the degree of resistance and is more marked in the middle periods of life, as it is thinner in the extremes of ages and in obesity. The female seems more resistant than the male; perhaps having been inured to more or less extravasation and absorption of blood during the menstrual cycle[9] and other things being equal in the athletic type of the male the peritoneum is less resistant than in the frail type. Furthermore, in the pelvic peritoneum there is a greater degree of effusion and diffusion than in the upper abdomen which would explain certain well known clinical phenomena. Extraneous conditions of disease seem to have little effect on these local processes of the peritoneum. It should be remembered that the surface area of the peritoneum is greater than that of the skin.

Without reference to the controversial question of drainage it may be stated that a rubber tissue drainage tube should be applied to unload the peritoneum of a surplus of questionable serum not sufficiently attenuated for final absorption before plastic exudate occurs. The wisdom of drainage in border line cases may be verified by the amount of serum discharged and the absence of such would indicate that the peritoneum would have taken care of its own burdens. There seems to be more agreement in the manner of treating active infections requiring drainage and mortality statistics in such cases are quite uniform, but the difference of the total mortality rates pertains more to closed incisions in which surgeons depends on these conservative peritoneal processes and lose occasionally.

There has been some debate as to whether infections arise from within or from without, but Schumann[2] seems to have proved that those of a serious type proceed from within and infections of the abdominal wall concern chiefly a question of morbidity. However, those from within are more serious and occasionally fatal but may be preserved by a treatment that favors the conservative functions of the peritoneum. Meyer[3] says that retroperitoneal infections increase 100 per cent in virulence as com-

pared with those in the open and obviously because of a lack of attenuation and diffusion and that any infolding process such as the stump of the appendix changes an everpresent degree of infection to a retroperitoneal type. Our own clinical studies[4] seem to corroborate that conclusion.

We take clean surgery to mean that closed incisions are in evidence of the application of a standardized aseptic technic and since there are no means for asepticising low grade bacteria our main reliance rests upon dealing with the contributing factors of infection. Granting the theory that every abdominal section with a closed incision is followed by some type of peritonitis the manner of treatment becomes obvious. The mechanical phases of the surgical abdomen have not received sufficient study for a low grade virulence of infection in the presence of tympany may occasion a fatal ileus while more active infections of the peritoneum in the absence of intra-abdominal tension would have a favorable outcome. Adynamic ileus and intestinal paresis are confusing terms that relate to a terminal pathology inaugurated primarily by mechanical conditions and low grade infections and secondarily by disturbances of the sympathetic nervous system from surgical trauma, etc.

So any extensive operation that has an empty gastrointestinal tract so far as gas is concerned is less likely to encounter these hazards. Securing an empty stomach is not so simple as it may seem for we have siphoned as much as 1000 c.c. of gas from the stomach of a patient weighing 90 pounds with a scaphoid type of abdomen after a tedious operation, before leaving the operating room using a Levine tube into an inverted bottle of water. Retching from anesthesia seems to create an ebb and flow of gas from the stomach to the duodenum along with swallowing air. Tympany should always be regarded with apprehension and daily palpation of the epigastrium should never be omitted.

The tentative use of fluids by mouth in the first three days of convalescence has a doubtful value for the reason that very little usually reaches the colon and invites stagnation with its disagreeable sequela. According to Howe[5] starving does not hinder the healing of wounds. Intense thirst will not be relieved by the oral intake of fluids and is better relieved by morphine. Acidosis is a bugbear that makes for meddlesome treatment. Postoperative temperatures in clean cases may arise from various causes but low grade infection undoubtedly have a share in these causes.

There is hardly a discomfort in convalescence that cannot be relieved by morphine which according to competent opinions[6] does not promote intestinal atony. A tight bandage is never necessary except in the presence of excessive vomiting. Any preventive treatment by eliminating contributing causes, must receive routine application and such a regime should eliminate any ambition on the part of staff members to individualize postoperative treatment and thus demoralize any standards of a nursing system.

For example closed incisions for acute appendicitis may be taken for a comparative study as furnishing the greatest degree of potential infection and a review of such records at long range would seem to justify certain conclusions. In an interpretation of our own recent report[7] of 1084 closed incisions, or 68 per cent of the whole series, with one death for a period of twenty-five years, barring an element of chance we cannot discern any material difference of environment and technique from other clinics except the application of the principles of the subject matter of this discussion, however commonplace they may seem. On the other hand in eight other hospitals[8] with several scores of operators with different standards of postoperative treatment for a period of five years 3411, cases of closed incision or 82 per cent of the whole series, gave 129 deaths, the mortality rates of 8 to 10 per cent for drainage cases being about the same in either instance.

SUMMARY

1. Absolute asepsis being only a dream, the presence of low grade bacteria in the peritoneum cannot be ignored in a study of the causes of the initial development of adhesions and the so-called aseptic peritonitis.

2. Clinical observations seem to corroborate the theory that in closed incisions there is a causative relation between low grade bacteria and the more active type of infections in promoting virulence through synergy and symbiosis and that further research studies should rationalize the process.

3. The fate of low grade infections is determined within the incubation period of the first three or four days yet not in evidence until later, possibly leading secondarily to active infection, or else extensive adhesions.

4. Every abdominal section is followed by an increased effusion of serum with a wider diffusion and requires a certain degree of physiological attenuation for resorption.

5. Mechanically harmless tissue tubes will drain wider spaces before the stage of plastic exudates.

6. A proper postoperative regime more or less negative in character will safeguard to a great extent these remarkable conservative processes of the peritoneum unless already overtaxed.

7. The contributing factors of infection are surgical trauma, incomplete hemostasis, dead spaces, tension, tympany, trauma from peristalsis and vomiting, restlessness, infection from the stump of the appendix, etc.

8. In view of the necessity of long range viewpoints the ambition for individualizing the postoperative treatment of the average case of closed incision will not lead to any reliable conclusions as to the mitigation of infections in general and is a menace to an efficient nursing regime; for preventive measures require to be standardized and more or less routine in their application and when a greater number of deaths in any large number of cases occur in closed incisions for appendicitis than result from grossly infected types a serious reckoning should be undertaken.

9. The oft repeated statement that the fate of the patient is sealed when the incision is closed should be protested.

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ANORECTAL FISTULA

ANATOMICAL CONSIDERATIONS AND TREATMENT

R. V. GORSCH, M.D.

Adjunct Professor of Proctology, New York Polyclinic Medical School and Hospital; Attending Surgeon, Proctology, Midtown Hospital; Assistant Attending Proctologist, New York Cancer Hospital

NEW YORK

THE operative treatment of anorectal fistula is one of the most ancient of surgical procedures having been recorded, according to Lockhart-Mummery, as early as 2200 B.C. Since that remote time much has been studied, discussed and written about it but the operative technique and the end results have changed but little since the classical description of the treatment of fistula by John Ardene in the fifteenth century.

Moreover, the pathological sequence in the formation of the common types of fistulas has been a controversial point, and there is still no complete or satisfactory or universally accepted explanation as to the exact pathways of the prefistula pathology, particularly the tuberculous variety.

It is not my object to describe the various operative procedures for the attempted cure of anorectal fistulas, which are available elsewhere; rather to call attention to the basic anatomical considerations, fundamental surgical principles and to describe an electrosurgical snare method which we have found useful in rectal fistulas with high internal openings. That surgery in this field is still unsatisfactory is well attested by a 20 to 50 per cent recurrence even in skilled hands.

It has been repeatedly observed that the anatomy of the anorectal region has been unduly neglected in medical training. Furthermore the modern surgical and proctological textbook fails to give a correct anatomical description of the anal musculature, particularly in their surgical relationship to fistula, fissure and hemorrhoids.

It is rather surprising that notwithstanding the vast amount of literature on fistula there is no complete agreement on the anal anatomy in the standard textbooks on proctology. Of course the descriptive anatomy has been handed down in biblical fashion which largely accounts for this fact.

All of this is not merely of academic interest for we are thoroughly convinced that much of the poor fistula surgery with its high percentage of recurrence and the varying degrees of resultant incontinence are in great part directly traceable to a lack of knowledge or misconception concerning the anal anatomy. Certain anatomical knowledge and considerations are absolutely essential to the practice of acceptable fistula surgery.

The cardinal fact in the surgery of fistula is the correct relationship of the internal opening or openings to the *anorectal line.* This has been emphasized and discussed in an excellent article by Milligen and Morgan, but has not yet received the attention which it merits from either the general surgeon or proctologist.

Other less important facts concerning fistulas, as the nature of the process, whether simple, tuberculous or otherwise, the postoperative care and complications have been discussed elsewhere and will not be considered here.

ANATOMICAL CONSIDERATIONS

There is still some confusion and disagreement regarding the anatomical arrangement of the external and internal anal spincters. Hiller, for example, in a detailed dissection of the anus concluded

that the external spincter was divided into superficial and deep layers and that the arrangement of the fibres was as

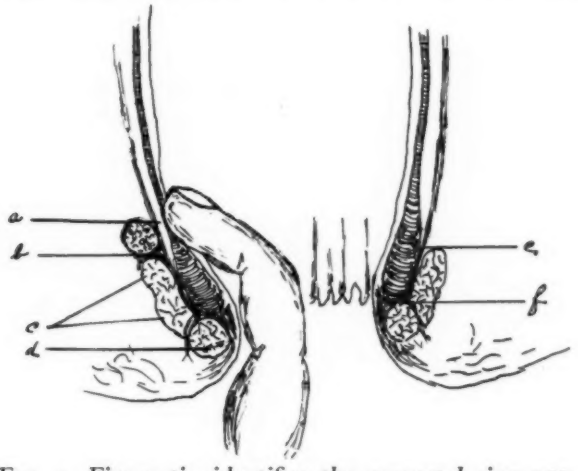

Fig. 1. Finger tip identifies the anorectal ring posteriorly. *a*. Anorectal ring posteriorly. *b*. Junction of profundus fibres of the external spincter with the puborectal fibres of the levator ani. *c*. Profundus and superficial portions of the external spincter ani. *d*. The subcutaneous portion of the external spincter ani. *e*. The anorectal ring anteriorly. *f*. The anal niche between the internal spincter ani and the subcutaneous external spincter ani.

follows "The external spincter consists neither entirely of fibres encircling the anus nor of fibres extending anteroposteriorly, but is a mixture of the latter type with fibres encircling the anus either anteriorly or posteriorly in varying proportions." He makes no precise distinction as to whether this arrangement applies in greater or less degree to the superficial or deeper portions of the muscle.

Milligen and Morgan, on the other hand, following along the descriptions of Holl, describe the external spincter as consisting of three layers, a subcutaneous, a superficial and a profundus.

The subcutaneous portion of the external spincter muscle nearly always surrounds the entire anal canal and its fibres do not extend, either crossed or uncrossed, posteriorly to be inserted into the sides or tip of the coccyx or anococcygeal body as is frequently but erroneously described and drawn in many textbooks. Anteriorly a few fibres may decussate.

The superficial layer is the one commonly referred to as the deep portion of the external muscle. It arises fairly constantly from the sides of the coccyx and anococcygeal raphe, splitting to surround the

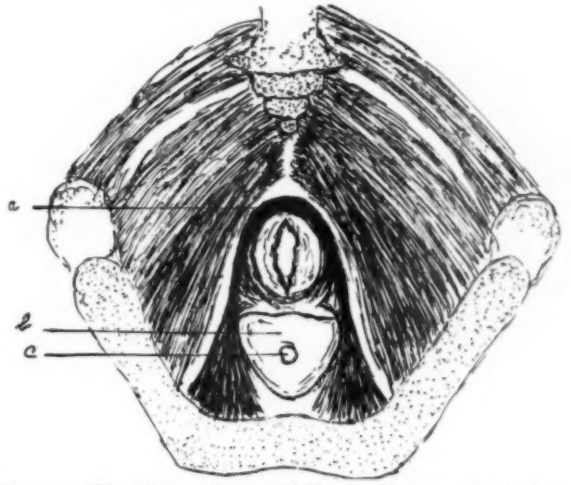

Fig. 2. *a*. Showing puborectal fibres of levator encircling the upper part of anal canal posteriorly. *b*. Prostate. *c*. Urethra.

midportion of the anal canal covering the circular and longitudinal muscles of the bowel, and continues to the central perineal tendinous point from which it may send ramifications to the skin.

The profundus layer is the deepest portion of the external spincter and similarly to the subcutaneous portion its fibres have an annular arrangement, entirely encircling the upper portion of the anal canal. Posteriorly it is in close apposition with the puborectal fibres of the levator ani and in conjunction with this muscle it forms the well defined upper margin of the anorectal ring. Anteriorly there are no puborectal fibres, because the levator has diverged laterally to its insertion in the lower pubes to surround the vagina in the female and the prostate in the male. The profundus fibres only, of the external muscle therefore forms the anorectal ring in the anterior half of the anal canal. (Figs. 1 and 2.)

These authors describe longitudinal muscle of the bowel as dividing into two or three fibromuscular septa which separate and insheathe the layers of the external muscle, particularly the subcutaneous portion. The continuation of the septum

downward has important connections of surgical significance. It passes between the lower border of the internal muscle and the upper border of the subcutaneous portion of the external spincter muscle, forming the anal intermuscular septum which is attached to the mucocutaneous junction of the anal canal at about Hilton's line.

These septal prolongations, furthermore, have some bearing on the spread of infectious processes and the ultimate location of the internal openings of fistulas. In the common, non-tuberculous type of fistula the infection probably arises in the bottom of a crypt, as Tuttle described many years ago, or in an abrasion of the mucosa. It then works its way out, usually above or through the subcutaneous external spincter muscle, following the fascial prolongations over the blood vessels as they pierce the anal fascia near the posterior midline, at 5 and 7 o'clock, the usual sites of posterior fistula openings. In this manner many infections reach the perianal and ischiorectal tissue. Hiller believes that the fascial covering of the blood vessels are important pathways for the dissemination of infections and clinical experience would seem to support this. The arrangement of the vessels, however, does not explain so readily the openings of high anal or rectal fistulas above the anorectal line or ring.

From the surgical standpoint of fistula, in particular, there are two important landmarks which deserve repetition and which in the operative technique should always be palpably recognized. These are, (1) the division between the subcutaneous external spincter muscle and the lower border of the internal spincter muscle, which also marks the insertion of the intermuscular septum; (2) the anorectal ring in its entire extent.

The classification of anorectal fistulas must be based on these simple recognizable landmarks and the ancient classification of complete, incomplete, blind internal and blind external, etc., which has been handed down with more rote than reason in the modern surgical and proctological texts, could be well discarded.

As already noted the cardinal fact of fistula surgery is the location of the internal opening in its relationship to the anal musculature and the anorectal ring, whatever the nature of the fistula. If this is not correctly established surgery usually fails and recurrence follows. The external openings are of minor importance from the surgical standpoint. Fistulas therefor may be classified as follows, modified somewhat from Milligan and Morgan.

CLASSIFICATION OF ANORECTAL FISTULAS

I. ANAL FISTULA
- A. Extraspincteric
  - 1. Subcutaneous
  - 2. Submucous
  - 3. Intermuscular
- B. Transsphincteric
  - 1. Low—opening just above or through the subcutaneous external spincter muscle; the common type.
  - 2. High—opening through the deeper portions of the external spincter, usually posteriorly but always below the anorectal ring.

II. RECTAL FISTULA
- 1. Anterior
- 2. Posterior
- 3. Lateral

Opening always above the anorectal ring.

This classification fails to differentiate fistulas opening into the bowel from those in which no internal opening is demonstrable, the so-called incomplete or blind variety.

But this, however, only serves to emphasize an important surgical aspect of the fistula problem in that, we question very strongly, whether the great majority of fistulas with no demonstrable internal opening should be treated surgically with

complete incision of the musculature. Graded external procedures, leaving the musculature intact, may in certain cases be justifiable.

In the patholysis of fistula it must be recognized that the original infectious track or tracks through the bowel wall may alternately heal over and break down. Therefor, the repeated injections with the proper technique and careful digital examinations of the tract is advisable to determine definitely the exact site of the internal opening before surgical intervention. This applies with particular emphasis to the frequently unsuspected tuberculous fistula.

The practice of opening and curetting tracts to the anal or rectal musculature with packing of the cavity in cases where no internal opening is demonstrable is a questionable practice. The anticipated hope that the internal opening "will take care of itself" is only too often realized, but by a recurrence.

The blind puncture of the mucosa, purposely or otherwise, in the belief that the true internal opening must be at that site, gambling on a satisfactory result, is also an unsurgical practice and should be discontinued.

Fistulas with two internal openings are usually overlooked. When found the higher opening should be dealt with first. If bilateral one side should be handled at a time, the higher opening first.

TREATMENT

The treatment of fistulas with low openings has been fully described and discussed in the standard proctologic textbook. Those however with high openings, through the deep portions of the external sphincter or into the rectum proper are sometimes difficult problems and we desire here to emphasize a few details in the operative technique and to describe an electrosurgical snare method which we believe has definite advantages in dealing with these high lying fistulas.

It is advisable to study a stereoscopic *x*-ray film of every patient with a fistula, as it may have an important bearing on the type of fistula and the anesthesia. There are no definite laboratory means of positively excluding tuberculosis in a fistula; negative microscopy and guinea pig innoculations are not conclusive. It has been our observation for many years that fistulas in patients who have or have had any degree of pulmonary or mediastinal tuberculosis should be regarded with suspicion.

The treatment of the extra-spincteric and the trans-spincteric fistulas with low openings entail but little fear of incontinence and spincter control. However, in those with high lateral openings through the deeper portions of the external spincter muscle there are several factors, usually overlooked, which may have an important bearing on the degree of resultant continence, a relative matter extending from the control of gas to a solid stool. These factors are, (1) the development of the anal musculature and its contractility, a tight or loose anal canal, sodomy, repeated dilatations, etc.; (2) previous divisions of the musculature resulting in scarring which interferes with the mobility of the muscles, and (3) diseases of the spinal cord, syphilis, diabetes, anemias, scleroses, etc.

The detection of the internal opening which can neither be palpated or probed, particularly in rectal or high lying anal fistula is facilitated by the injection of colored solutions or paste. Methylene blue in 50 per cent peroxide is our choice. It should not be injected with pressure. Under direct inspection of the entire anal canal and lower rectum the entrance of the blue is readily observed. The modified electric lighted wire speculum, shown in Figure 3, has been used by the author with great satisfaction. The entire anal canal is visible at one time and no matter where the internal opening may be it is usually readily observed. This speculum is likewise useful in incising submucous, submuscular and intermuscular fistulas. It is partly

adjustable to the anesthetized anus, and should never be used without some form of anesthesia.

Fig. 3. Author's electric lighted wire speculum.

In scarred cases which have been operated several times this visual inspection affords the only means of accurately finding the internal opening before operation. Palpation alone in these cases may be misleading. There would be a decided improvement in the percentage of recurrence, now 30 to 50 per cent, if the internal opening were observed before surgical intervention. There is little hope of permanent cure unless the true pathological opening or openings are found and their anticipated exhibition during the surgical dissection is only too frequently disappointing and results in ill advised probing, curettings and packings.

In fact we seriously doubt the advisability or justification of surgery in fistulas, particularly the high anal and rectal types, where no internal opening is demonstrable and this applies particularly to those with lateral internal openings. Milligen and Morgan advise an extensive drainage procedure in these cases, without incision through the muscles; but one must admit the possibility of such fistulas resulting from infectious processes arising in the intramuscular glands of the rectal wall or those extending into the levator muscles. The importance of these glands in the etiology of fistula was observed by Hermann and Desfosses and more recently by Gordon-Watson and Dodd who report 3 definite cases of this type of fistula. Obviously the original pathways of infection from the rectum to the glands must be entirely eradicated to assure a favorable result and the extensive surgery, despite the adequate drainage and careful after-rare, is fraught with the danger of recurcence and incontinence. Certainly such cases should only be handled by experienced and skilled proctologists.

Where surgery is contraindicated or refused the injection of irradiated vaseline combined with carefully administered deep *x*-ray therapy may be of some palliative value.

In these high lying fistula we have used with complete satisfaction a method of setonizing the tract with wire and cutting it down by steps with the electric snare. The method was first described by the author in 1933 to the American Proctologic Society and has since been used by Yeomans, Frankfeldt and others.

It offers a rapid, safe and bloodless method of lowering the internal opening with little fear of incontinence in these particularly difficult fistulas. The technique is essentially as follows.

ELECTRIC SNARE SETON

Tonsil snare wire or preferably pure silver wire which is easier to manipulate, is drawn through the tract on a probe with a fenestrated tip. As a preliminary step the external portion of the tract with all its ramifications should be *excised*, shortening the main tract to within an inch or more of the anal musculature. It may be advisable to do this in stages if the excisions leave overhanging or too irregular skin edges which result in depressed and cavernous scars. The wire may be left in place until the external wounds have healed to the desired supportive points.

When the tract is to be cut down, the inner limb of the wire loop is insulated with a piece of bakelite or hard rubber tubing which protects the anal and rectal mucosa during coagulation. The wire ends

are then attached to the electric snare (Fig. 4). The loop now ensnares the muscles and is drawn taught as the current is applied. The wire cuts through the tissues depending on the amount and type of current and the rapidity with which the loop is pulled down. It is advisable to use a slow cutting current with considerable coagulation in its wake, so-called coagulotomy current, since bleeding may be free. The tissues are quickly separated and one must know his machine settings. Preliminary tests on raw meat are advisable. The method is not as simple as described but is effective and superior to other seton methods. The final wound through the entire anal musculature and into the perianal tissues should afford adequate drainage, which must be secured even at the expense of cutting the skin wound well out, a second time.

This method is likewise applicable and may prove successful in rectovaginal fistula in which the usual plastic operative procedures are refused. If it is not successful it can do no harm.

It may also prove of value in fistulas arising from bartholinitis with long perineovulval tracts, in which one stage operative procedures produce large gaping wounds with disabling scars.

SUMMARY

The anatomy of the anorectal musculature has been reviewed, particularly in its etiological relationship to fistula. A modified classification of anorectal fistula has been presented based on the location of the internal opening in its relation to the anorectal muscular ring. The surgical significance of this relationship in the successful treatment and more particularly in the preservation of anal continence, is emphasized.

An electrosurgical snare seton method is presented, which in the author's hands has proved a valuable and satisfactory technique in the treatment of difficult fistulas with high anal or true rectal openings.

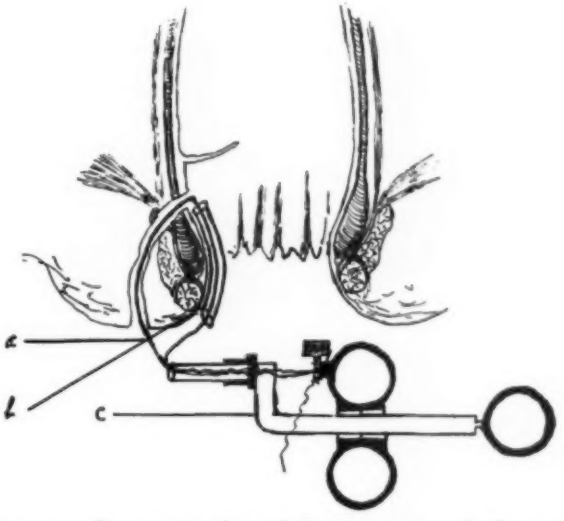

Fig. 4. *a*. Snare wire through fistulous tract. *b*. Curved bakelite tube to protect anal canal. *c*. Snare, bipolar technique.

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MODERN METHOD FOR PREVENTION OF POST-OPERATIVE DISTENTION*

A REPORT OF 88 CASES

WILLIAM R. LEVIS, M.D. AND E. L. AXELMAN, M.D.

PHILADELPHIA

POSTOPERATIVE intestinal atony is an all too familiar picture complicating convalescence. It is the purpose of this report to call attention to the results attendant upon our investigation of a new compound designed to abolish the appearance of this entity.

Theoretical discussion of postoperative intestinal atony is scarcely warranted here. This condition has been admirably discussed in a number of papers and so thoroughly classified both as to type and etiology that additional discussion would be burdensome and out of place.

Schumann and Missett define paralytic ileus as a motionless distention of the intestines due to paralysis of the muscular tunic of the bowel, and differentiate this type of ileus from dynamic ileus where hindrance of propulsion and expulsion of the intestinal contents is due to a definite mechanical obstruction somewhere along the course of the bowel. Our concept of postoperative intestinal atony is identical and we regard postoperative intestinal atony as a paralysis of the muscular tunic of the bowel attended by a moderate to extreme distention of part or all of the intestinal tract in the absence of any obstructive lesion.

Regardless of which cause is ascribed as being productive of postoperative intestinal atony, it is reasonable to state that this cause in most instances, is a direct or indirect sequel of surgical interference.

Many feel that the appearance of postoperative intestinal atony is, in a sense, an indictment of the surgeon, and while it cannot be denied that poor surgical technique and unnecessary handling of abdominal viscera increases the degree of intestinal atony, the appearance of this entity is not indicative of poor surgical technique. Practically every laparotomy has some degree of distention due to postoperative intestinal atony. The importance the condition assumes is in direct proportion to the degree of distention and the discomfort suffered by the patient. Despite the fact that many cases are so mild that they escape detection and spontaneously correct themselves with no therapeutic help, the fact remains that every laparotomy develops intestinal atony of varying degree. This is not surprising as mere opening of the abdominal cavity suffices to inaugurate intestinal atony of some degree.

The clinical picture of postoperative intestinal atony is well known, the ballooning belly attended by interference with circulation, toxemia, respiratory embarrassment and pain. Early therapeutic efforts were devoted to the correction of the established or developing condition. These efforts were concerned chiefly with the relief of pain and correction of the distention. Such treatment is therapeutically sound for correction of distention is soon followed by a remission of the concomitant symptoms. Attention to pain was forced by the insistent demands of the patient.

One of the earliest agents used in treating postoperative intestinal atony was morphine and strangely enough, continues to be used today. Such therapy amounts to ostrich like behavior, for we flatter ourselves that by abolishing pain through overwhelming the higher centers with opiates we have corrected the condition even though the physical status of the patient remained unchanged, as evidenced by the objective signs of distention. It

* Read before the Staff Meeting of the Crozer Hospital, December 23, 1935.

cannot be argued that this early therapy utilized the stimulating influence of morphine upon the muscular tunic of the intestinal walls. Moreover, analgesic doses of morphine sufficient to control the pain of postoperative distention may, and usually do, result in conversion of the generalized atony into spastic contractures alternating with areas of distention forced by pockets of imprisoned gas. An unpleasant picture and one completely masked by the analgesic effect of the opiate used.

The employment of extracts of the pituitary gland was a more rational therapy and a step forward in that the cause was being treated and not the effect. One objection to the use of pituitary gland products is that the action is not constant. Some maintain that the primary action of the glandular products is depression, succeeded by undesirable hypermotility and regardless of the dosage used a constant uniform action cannot be secured. Another objection to pituitary medication is the frequent occurrence of blanching reactions which have a terrifying effect on the patient and are not without actual danger.

Physostigmine or eserine has been employed in the treatment of postoperative intestinal atony. The effect on the bowel is good and the action is uniform and pronounced. Unfortunately, however, the stimulation of the entire parasympathetic system elicits a variety of effects, in addition to that upon the intestinal musculature particularly an effect upon the cardiovascular system. Moreover, eserine is distinctly toxic to the central nervous system, particularly the spinal portion. Due to its high toxicity and the variety of side effects elicited through its use, eserine has not been widely employed.

Duodenal suction siphonage by nasal catheter has afforded very satisfactory results, but this method is usually not employed until distention appears. Moreover, its efficacy is best exemplified in those conditions where there is obstruction, as dynamic ileus. Is it not possible in true adynamic paralytic ileus that such a measure will relieve only gas that is imprisoned rather high in the intestinal tract leaving untouched the lower portions? The same objection applies to the use of the rectal tube and enemas, which may serve to empty the lower portion of the intestinal tract but leave untouched the higher portion.

Of the older drugs which have been used postoperatively for distention, eserine salicylate administered parenterally has been attended, perhaps, by the most satisfactory results. The unpleasant by-effects which so often follow the administration of eserine led to various investigations of compounds possessing similar physiologic activity but lower toxicity. Stedman demonstrated that a substituted phenyl ester of a replaced carbamic acid or of carbamic acid itself possessing a basic group, will in general exhibit physiological activity similar to that of eserine. This work led Aeschlimann and Reinert, among others, to systematic investigations of urethanes of this type. Following exhaustive researches, Aeschlimann and Reinert found that of the substances synthesized and studied, the dimethyl-carbamic ester of 3-hydroxyphenyl-trimethyl ammonium methyl-sulphate exhibits pharmacologically the most promising effects. Subsequent clinical trials substantiated results obtained in animal experimentation.

This substance has been introduced into the materia medica under the trade name prostigmin. Chemically, it is a synthetic compound resembling eserine but differing from the natural alkaloid by its less complicated structure and its greater stability. Pharmacologically, in comparison with eserine, prostigmin is marked by a more pronounced action on smooth muscle tonus, a less pronounced miotic effect and the almost complete absence of cardiac by-effects.

Aeschlimann and Reinert, in their studies on the isolated frog heart found that eserine in a concentration of 1:1000 will often stop the heart in diastole, whereas in identical concentration, prostigmin causes at most a slight decrease

in amplitude. A one per cent solution of eserine almost invariably stops the heart in diastole, whereas solution of this concentration of prostigmin usually causes only a decrease in amplitude. On the isolated rabbit intestine prostigmin is still active in dilutions of 1:5,000,000; in some cases, a definite increase in tonicity was found even in dilutions of 1:7,500,000. On the intestine in situ, the effective intravenous dose is 0.02 mg. per kilogram.

Berk found that the isolated frog heart subjected to the action of strophanthin, will stop the heart in diastole following a five to seven minutes' treatment with a 1:2000 solution of eserine salicylate. Under similar conditions, prostigmin solutions of varying concentrations of 1:500 to 1:8000 is without influence on the action of strophanthin. The heart will stop in systole.

Rothschild compared the action of prostigmin with that of eserine on the normal isolated small intestine of the guinea pig. Prostigmin has a decidedly stronger peristaltic action than has eserine on the intestine rendered atonic either by atropine or epinephrine. Prostigmin restores tonicity to a greater than normal degree. Under influence of papaverine the tonus of the intestine slowly decreases. Treatment with prostigmin checks this decrease and gradually stimulates the intestine almost to the normal point. Eserine, under similar conditions, causes great variation of tonus but does not restore normal peristaltic conditions. The tonicity remains below its initial level.

Until recently the use of prostigmin in the field of surgery has been restricted almost solely to postoperative application as a treatment for distention and atony of the urinary bladder. For this purpose, 1 c.c. of a 1:2000 ampule solution is employed. A solution, having a concentration of 1:4000, is now available, prostigmin prophylactic, for use as a prophylactic against distention and bladder atony. A technique of administration has been developed, and it is recommended that the contents of an ampule, 1 c.c., be administered every six hours, starting a day before operation and continuing until the second or third postoperative day.

There are more than one hundred papers concerning the use of prostigmin in clinical application, and a number of the authors refer to the value of the drug as a prophylactic agent. In cases where adhesions existed, or were feared, Beck used routinely 0.5 c.c. of the 1:2000 prostigmin solution as a prophylactic and to maintain peristalic movements. Jeanneney, in a report on the effectiveness of prostigmin, calls particular attention to a case of mechanical ileus in which the drug was used both pre- and postoperatively. Mueller uses a prophylactic dose of prostigmin twelve to twenty-four hours after the treatment dose is administered.

It seemed important to perfect a technique for the prevention of postoperative intestinal atony. We define the preventive or prophylactic treatment of postoperative intestinal distention as the employment of small doses of the active agent administered at frequent intervals, beginning before the appearance of distention and continuing until the condition of the patient indicates that the danger has passed. Some feel that such prophylactic treatment may be instituted twenty-four hours before operation and continued two to three days following operation. We have preferred to start the prophylactic treatment shortly after or at the time of the operation and continue as necessary. This anticipatory type of treatment is justifiable in view of the fact that the incidence of postoperative intestinal atony through our technique has been reduced to a negligible minimum; prior to its use fully 60 to 75 per cent of our cases showed a varying degree of atony.

Our series numbered 88 cases, in which the application of prostigmin as a prophylactic against distention has been attended by satisfactory response. The routine in most of our cases, as we have stated, has been to start injections of prostigmin at the time of operation or shortly thereafter and continue injections for twenty-four

to forty-eight hours at four to six hour intervals, or until such time that we felt the condition of the patient indicated no further need of this medication. The last injection of prostigmin was followed by a soapsuds enema. The following are five representative reports of cases in which prostigmin has been applied prophylactically:

Case I. Mrs. L. W., age, fifty-two years, complained of epigastric distress four hours after eating, vomiting, and loss of weight for the past two years. Provisional diagnosis of gastric carcinoma was made. The laboratory findings showed the urine to be negative; the leucocyte count 8450, erythrocyte count 5,250,000, hemoglobin, 84.4 and color index, 0.8 per cent. Analysis of the gastric contents revealed occult blood to be absent, free HCl 59.2 per cent, total acidity, 76.7 per cent and combined acids and acid salts 16.43 per cent. *X*-ray inference was carcinoma of the pyloric end of the stomach. At operation a mass was found at the pyloric end of the stomach. A partial gastrectomy was done with anastomosis of the duodenum with the greater curvature of the stomach. Six hours post operatively prostigmin medication was started; second dose four hours later and the third given the following morning, eight hours after the second dose, followed by three additional injections at six hour intervals. Signs of distention disappeared, vomiting stopped and patient began gaining weight.

Case II. H. Z., age twenty-five years, diagnosed perforated gastric ulcer, complained of epigastric pain, nausea, vomiting and abdominal distention. The patient gave a history of indigestion over a long period of time followed by severe attacks of epigastric pain and in turn by abdominal distention. Operation revealed a perforated gastric ulcer which was repaired by excision of the ulcerated area. Prostigmin in this case was given every six hours for six doses starting four hours after operation. Morphine and atropine were given and possibly necessitated a subsequent dose of prostigmin. The patient made a complete uneventful recovery.

Case III. C. G., age thirty-eight years, diagnosed perforated gastric ulcer, complained of pain in right hypochondriac and epigastric regions, nausea and vomiting. There was a history of indigestion over a long period of time followed by sudden sharp pain. Operation revealed a ruptured gastric ulcer which was excised and the gastric wall repaired. Morphine and atropine were given in this case for relief of the pain. Prostigmin was given four hours after surgery and at four hour intervals for six doses and a seventh dose in two days because of slight signs of distention. This was given after a dose of morphine and atropine and we believe that the slight distention was due to the atropine. The recovery was uneventful.

Case IV. D. O., age fifty years, diagnosed, acute gangrenous cholelithiasis, complained of pain in right upper abdomen. There was a history of attacks of indigestion for a period of eight years in turn followed by severe pain in right upper abdomen and accompanied by severe chill. Operation revealed a perforated gangrenous gall bladder which was markedly hypertrophied. Prostigmin, 1 c.c., was given four hours after operation and continued for six doses at intervals of four hours. Recovery was uneventful, no distention being noted at any time.

Case V. Mrs. I. S., age forty-one years, diagnosed chronic endocervicitis, chronic appendicitis, chronic bilateral salpingitis, bilateral cystic ovaries, prolapsed uterus, complained of foul vaginal discharge, bearing down sensations and generalized abdominal pain. There was a history of foul leucorrhea for two years accompanied with fatigue. Operation consisted of bilateral salpingectomy, bilateral partial oophorectomy, dilatation and curettage, Gilliam suspension of uterus and appendectomy. Prostigmin, 1 c.c., was given five hours after surgery. Two doses given on the first day and four the next day, a soapsuds enema following the last injection of prostigmin. No abdominal distention was noted at any time. She made an uneventful recovery.

DISCUSSION

Review of the 88 cases forming the basis of this report show that prostigmin prophylactic has been most valuable in combating the much dreaded symptoms of postoperative distention and gas pains. In comparing these case records with an analogous series prior to our use of prostigmin prophylactic, we have found that distention and gas pains have been reduced to a negligible minimum. Prior to its use fully 60 to 75 per cent of our cases would show either

subjective symptoms of gas pain or objective signs of gastrointestinal atony or both.

Prior to the use of this product the glandular preparations were generally employed but our results were not sufficiently uniform to warrant continuation of their use.

After some experience with this product and with the thought in mind of finding the dosage technique which would give maximum results the following routine has been established. With inhalation anesthetics, the first injection of prostigmin prophylactic is given three to four hours after operation followed by a second injection four hours later; four injections are given at four hour intervals the first day after operation. The last dose of prostigmin prophylactic is followed immediately by a low soapsuds enema. This technique has proved very effective in preventing postoperative intestinal atony.

It will be noticed that the use of this product has been made routine since it is our opinion that it is good practice to prevent this dreaded condition rather than to wait until the patient complains of gas pains or distention is evident.

Most gratifying to the patient and nurse, as well as the surgeon, is the elimination of repeated high compound enemas, as milk and molasses, etc., rectal tubes, etc. for the relief of this painful and annoying condition.

It has been our experience that with this method of administering prostigmin prophylactic peristalsis has been established within twenty-four hours after operation, whereas prior to our use of prostigmin in abdominal cases peristalsis was not established until after a period of forty-eight and in some cases seventy-two hours.

Our use of prostigmin has not been attended by any untoward effects by way of systemic or local reaction, the blood pressure is not affected and cardiac action is not interrupted in any way.

SUMMARY AND CONCLUSIONS

Prostigmin prophylactic is a 1:4000 solution of the dimethylcarbamic ester of 3-hydroxyphenyl-trimethyl ammonium methylsulphate. It is available in ampules delivering 1 c.c. of the solution.

We have applied prostigmin prophylactic as a prophylactic against distention in 88 cases. A satisfactory response has followed medication in practically all of the cases.

Prostigmin prophylactic has proven the most effective preventive of postoperative intestinal atony that we have investigated thus far.

No by-effects, such as might be expected when effective doses of eserine are administered, have been observed.

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PROTEIN METABOLISM*

DISTURBANCES UNDER CONDITIONS OF SHOCK AND SURGICAL INTERFERENCE

A. LURJE, M.D.

Member of the Faculty, Surgical Clinic, and of the Central Laboratory for Scientific Research

MOSCOW, U. S. S. R.

UNDER ordinary conditions of life the protein metabolism is characterized by a certain constancy and is much less subject to changes caused by protein intake and pathological conditions than the more labile fat metabolism and the metabolism of carbohydrates. The concentration of "amino-N der Basen" in the blood, as an indicator of the content of the fundamental intermediate link in the protein metabolism, represents a more or less stable value showing transitory and insignificant changes after food intake and a considerable tenacity in the presence of pathological changes in the organs controlling protein metabolism.

Referring to the experiments on excision of the liver (Bollman, Mann, Magath), Van Slyke points out the fact that the removal of about 90 per cent of this organ, to which numerous physiological and clinical investigations ascribe the predominant role in the process of protein metabolism, was found to cause a rise in the amino-acid content of the blood. The work of Reiche,[2] Bufano[3] and others has shown that the increase in the amino-N in the blood under conditions of human pathology occurs chiefly either in cases of general disturbances of tissue metabolism or in those of severe liver damage (acute yellow atrophy, cirrhosis, etc.), these changes being sometimes demonstrated only by a more prolonged rise and a slow fall of the amino-N curve after test glycocol intake.

We decided to use the relative tenacity of the protein metabolism in pathological conditions, as compared to that of other forms of metabolism, for studying the degree of disturbance of the intermediate metabolism in conditions of serious operations leading sometimes to shock conditions, in cases of head injuries and in a number of experiments. With this purpose the amino-nitrogen in the blood of a group of seriously ill patients was studied repeatedly according to the Van Slyke gastrometric method on the micro-amino apparatus. Sixty-five patients were examined; 14 had been operated for the relief of cranial and cerebral disease; 6 had been admitted with head injuries; in 8 operations had been performed for pulmonary disease and in 13 for stomach disease.

During the operation in each case blood pressure and pulse rate were determined. Blood was withdrawn before operation at the time of the most marked disturbance of the general state, as indicated by a considerable fall in blood pressure reading, a failure in the general reaction under local anesthesia, profuse sweating, pallor and acceleration of the pulse rate. These symptoms in their various combinations and successions characterize the erectile and torpid phases of shock (Burdenko[5]) or conditions near shock.

In the group of patients in whom no disturbance of the general state was observed, blood was taken after a preliminary analysis at the end of the operation and later only when a second analysis showed some change. In analyzing our material attention was paid first to the factor of absence of a similar reaction (as concerned the quantitative increase of amino-N in the blood) in cases where the same organs were equally damaged, the same methods of anesthesia and of opera-

* From the Faculty Surgical Clinic, Chief, Honorary Prof. N. N. Bardenko, and The Central Laboratory for Scientific Research, Chief, Prof. S. J. Tchetshulin.

tion being used. This must be attributed to the individual ability of different organisms to regulate their protein metabolism and the amino-N equilibrium in the blood.

Our patients with cerebral diseases demonstrated that operations on the brain, being associated with a direct or reflex irritation of vegetative centers of the cerebral trunk, caused an increase of amino-acids in the blood from 8–10 mg. to 19–35 mg. per cent. If we consider the fact that our patients had a preoperative preparation of a twelve to fifteen hour fast and preliminary purgation, the natural assumption is that the increase of the amino-N volume in these cases was due to reflex endogenic breaking down of the proteins of the organism.

One woman with an intramedullary tumor of the third to sixth cervical vertebra and a tetraplegia, having a high amino-N level in the blood before operation, showed a fall of the amino-N volume from 22.4 to 17.4 mg. per cent, attended by weakening of the paralytic disturbances in the upper limbs after decompressive laminectomy with exposure of the spinal cord and its longitudinal dissection according to Elsberg. The last circumstance is attributed to the decompression of the remaining spinal cord. Freund and Grafe[6] found that in animals section of the spinal cord, even at a lower level (D5), produced by itself a 40 to 50 per cent increase in the amino-N in the blood. These authors associate this phenomenon with the absence of heat regulation. Thus the state of the patient in the period preceding operation can be compared approximately to the state of the experimental animals after the operations performed by Grafe and Freund, although the heat regulation of the patient during profuse sweating was maintained and the temperature sense as well as the sense of pain and tactile discrimination were also maintained on various areas of the body. The diminishing of the paralytic phenomena in the upper limbs after operation as one of the symptoms of decreased compression of the spinal cord, followed by a fall in the amino-N level in the blood, witnesses a decrease of irritation caused by the compression of vegetative paths and an improved regulation of the protein metabolism.

Among our patients with head injuries, 2 with fracture of the base of the skull without increase of intracranial pressure, as shown by lumbar punctue , and attended by an intracranial hemorrhage, exhibited a higher content of amino-N in the blood. In one of these cases, during a deterioration of the general state before death, a still higher content of the amino-N was observed. In the other case some improvement of the pulse rate and respiration, and return of consciousness, were followed by a fall of the amino-N levels in the blood.

One patient with a fracture of the os parietale, admitted with a high amino-N level in the blood, 21.2 mg. per cent, after the removal of pieces of bone pressing on the brain and a lumbar puncture showed a fall of the amino-N content of the blood to 11.2 mg. per cent. In 3 cases of commotio cerebri, 2 being most severe with suspected subarachnoid hemorrhage, an increased content of the amino-N was observed.

That change in the amino-N equilibrium is dependent upon reflex influences arising as a result of trauma under conditions of surgical intervention, is shown by our pulmonary operations. Thoracoplasty performed in cases of pulmonary abscesses and tuberculosis and consisting of resection of the lower ribs under paravertebral anesthesia was followed by a fall of the amino-N level in the blood although it usually led to severe damage to the general state with a considerable fall of the blood pressure, cold perspiration and weakened ability to react. The paravertebral anesthesia (D5–D12) abolished the conductivity of the respective portion of the splanchnic nerve. This fact was evidently due to reflex breaking down of endogenic proteins as a result of partial exclusion of the liver innervation, which in cases of

trauma reacts first by excretion of amino-acids. These findings agree perfectly with the results of researches by Hirschorn and Popper,[7] who obtained a fall of the amino-N curve after alimentary intake under paravertebral anesthesia.

Other pulmonary operations, as the insertion of extrapleural paraffin fillings, opening and drainage of abscesses, upper thoracoplasty performed under genera anesthesia as well as local, all produced a considerable increase of amino-N in the blood.

Stomach operations in cases of chronic disease also caused an increase of the amino-N in the blood, where the surgical intervention was carried out under local anesthesia combined with ether or under ether and avertin. The increase amounted from 8 to 12 to 17 to 25 mg. per cent. An exception was observed in 2 cases where splanchnic anesthesia was used, which apparently excluded the possibility of the reflex reaction of the liver in the form of excretion of amino-N into the blood. Five cases of perforated gastric ulcer observed and examined by us exhibited a somewhat different picture. Perforation of the ulcer is attended by an acute painful irritation having its greatest intensity during the first three to four hours after the perforation occurs. In our 3 cases the patients were admitted a few hours after the perforation and as a result of this intensive irritation we found high figures for the amino-N content, 17 to 19 mg. per cent, which decreased to 12 to 17 mg. per cent after the administration of morphine and anesthesia, even in spite of surgical intervention. The patients with perforated ulcer of the stomach who were admitted in a later stage of the disease showed a weakened endogenic breaking down and an improved regulation of protein metabolism. Here we observed the usual reaction: increase in the amino-N at those periods during operation associated with the most severe trauma and the possibility of a reflex irritation.

Ether and local anesthesia, which were used chiefly in the operations discussed, produced an insignificant toxic effect upon the amino-N equilibrium even when administered over a prolonged period. This was confirmed by a number of simple operations, as contracture of Dupuytren, chronic appendicitis, hernia, etc. In 6 cases with avertin anesthesia we observed a higher amino-N level in the blood than when other forms of anesthesia were used. The highest contents of amino-N were found in 2 cases of avertin asphyxiation (34 and 42.7 mg. per cent). Thus, in agreement with Vallebona Ubaldo, we are ready to attribute to the avertin a toxic influence on the liver and tissues, leading to an increase in the amino-N content of the blood.

In our experiments on animals we also tried to determine the influence of different forms of trauma on the regulation of the endogenic breaking down of proteins. For this purpose, in addition to clinical observation, we made analyses of the blood of cats and dogs subjected to diverse forms of trauma without the administration of any anesthetic. Head injuries attended by disappearance of the pain reaction, weakening of reflexes and loss of consciousness were found to cause a 40 to 50 per cent rise of the amino-N level of the blood. Experiments on traumatic shock provoked by inflicting crushing wounds of the limbs and creating strong painful irritations, although they did not always lead to a shock condition, nevertheless were usually attended by a gradual fall in the blood pressure after initial rises and showed a considerable increase of amino-N in the blood. We further attempted to create a strong irritation by inflation of the stomach by means of a metreurynter introduced through an esophagotomic orifice in the neck. The inflation was continued until the stomach ruptured, which was followed by a considerable pressure on the liver and damage of the respiratory excursions, of the lungs as a result of pressure on the diaphragm. These experiments also led to a rise of the

amino-N level of the blood although its mechanism consisted not only in a reflex increase of the endogenic breakdown of proteins but apparently also in increased excretion of amino-N into the blood from the liver as a result of the immediate considerable compression of this organ.

To allow a clearer conception of the mechanism of the reflex increase of amino-N in the blood a number of experiments were made in cases of commotio cerebri with blocking of the nerves of the liver. The blocking was produced by injecting novocaine in the hepatoduodenal ligament and in the lesser omentum. In the last case we failed to observe any increase in the amino-N in the blood during the first hour after the trauma. Afterwards a slight increase of this component was found. This may be explained by the breakdown of the proteins in the tissues.

To conclude the review of our clinical and experimental data we would note that severe disturbances and fall of blood pres-

TABLE I

Case No	Age	Diagnosis	Operation	Anesthesia	Mgm. Per Cent Amino-N in Blood before Operation	Changes in General State Caused by Operation	Mgm. Per Cent Amino-N in Blood at End of Operation	Condition of Patient Postoperative	Mgm. Per Cent Amino-N in Blood
1	26	Left pulmonary abscess	Resection 7th and 8th ribs; removal of extrapleural filling; opening of abscess	Ether 80.0	10.5	Diminution of pressure from 116 to 110 mm.	19.4	Satisfactory 4 hours after operation	12
2	17	Right pulmonary abscess	Resection 5, 6, 7, 8 and 9th ribs; removal of filling; opening of abscess	Ether 90.0	7	Fall of blood pressure at end of operation up to 95; cold perspiration; shock condition	25	Shock condition in 20 min. in 40 min. 6 hours after operation patient improved	 24.5 25.2 14.4
3	33	Right pulmonary abscess	Resection 3, 4 and 5th ribs, between lower left axilla, anterior and posterior; introducing filling	Infiltration anesthesia novocaine 0.5 per cent	11.9	Fall of blood pressure at end of operation up to 95; cold perspiration; shock condition	22.1	30 min. after operation; shock condition 3 hours after operation, patient improved	21.8 11.7
4	39	Right pulmonary abscess	Resection of 5 upper ribs under local anesthesia	Infiltration anesthesia novocaine 5 per cent	8.4	Some weakening of reaction; small diminution of pressure; sweating	28	5 hours after operation	10.8
5	28	Left pulmonary abscess	Resection of 8–13 cms. from 6–11th ribs	Infiltration plus paravertebral anesthesia	17.5	Fall of pulse rate; shock condition	16.2	1½ hours after operation, patient improved	12.7
6	35	Right pulmonary abscess	Resection 6, 7 and 8th ribs	Paravertebral anesthesia D-5 to D-9	17.4	Sharply marked fall of blood pressure and reaction; shock condition; cold sweat	12.2	2 hours after operation, patient improved	12.2
7	37	Right pulmonary abscess	Resection of 7–12 cms. from 6–11th ribs	Local plus paravertebral anesthesia	12.6	Sharply marked fall of blood pressure and of reaction; sweating; shock condition	11.9	4 hours after operation, patient improved	12.6
8	23	Right pulmonary abscess	Phrenic avulsion; resection of 8–12 cms. from 7 ribs on right side below	Local plus paravertebral anesthesia	12.2	Fall of pressure from 120 to 70 mm.; weakening of general reaction	12	5 hours after operation, patient improved	11.8

sure, weakening of the general reaction and cold sweating, the so-called shock condition, appear to develop in man and animals as a result of prolonged and severe traumas, which by themselves in the period preliminary to the shock lead to a considerable increase of the endogenic breaking down of proteins. The shock condition proper, especially in its torpid phase which is most suitable for study, appears to be connected with a severe alteration in the hemodynamics attended by an accumulation and retention of the blood in the liver (Burdenko, Smirnova[8]), exhaustion of the peripheral and central vegetative nervous system and damage of the conducting capacity. In consequence, the amino-N component of the blood remains quantitatively stable during the whole period of the shock condition of the patient. This is demonstrated by our observations in cases in which blood taken several times from patients in a shock condition has not shown any further change in the amino-N content. The surgical intervention by itself in these cases was not associated with a total or partial blocking of the nerves of the liver.

CONCLUSIONS

1. Severe surgical traumas in cases of intact innervation of the liver always lead to an increase of the amino-N content of the blood which appears to be the result of a reflex provoking endogenic breaking down of the proteins. Operations of the same degree of severity but associated with a partial or total exclusion of liver innervation by paravertebral or splanchnic anesthesia do not cause any increase in the amino-N content of the blood.

2. Severe head injuries and perforations of the stomach in early stages of disease show a high amino-N level of the blood.

3. Experiments on animals showed that diverse traumas cause an increase of the blood amino-nitrogen. Traumatic influences with blocking of the nerves of the liver do not cause any change in the amino-N content during the first hour.

4. A shock condition after prolonged hyperirritation associated with a rise in the amino-N level of the blood is characterized by a stabilization of the examined component; it appears to be the result of a severe disturbance of the hemodynamics with accumulation of the blood in the liver attending the shock, and lasts until the period of shock is over.

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FROST-BITE

THEODORE KAPLAN, M.D.

Peripheral Vascular Clinic, Gouverneur Hospital, New York City, and St. Johns Riverside Hospital, Yonkers

NEW YORK CITY

FROST-bite is a local condition due to the action of cold upon tissues of the body as a result of which an area is deprived of its blood supply. Not only does exposure to extreme degrees of cold cause this condition within a short period of time, but exposures to moderate degrees of cold over a long period of time may have the same effect.

The process may occur in three forms, (1) mild, the stage of erythema, (2) moderate, the stage of vesiculation, and (3) terminal, the stage of gangrene. The occurrence of gangrene is seen more frequently in temperate climates than where extreme degrees of cold prevail, as in the Arctic Zone. One might explain this seemingly paradoxical absence of gangrene in regions where it would be expected to be rampant by the adaptability of the individual to the environment and the knowledge and use of prophylactic measures.

A reduction of temperature to or below freezing point of blood is not necessary to cause freezing of tissue, for it may occur even when blood temperature remains above zero, providing the following factors are present.[1]

1. *Moisture:* The transfer of cold air to the body is made more readily through a moist rather than through a dry medium, based on the laws of conduction. Chilling by cold air plus moisture, as through wet clothing, takes place through conduction. Chilling by cold air alone, takes place through the process of radiation, which gives the temperature of the parts affected more chance to adjust itself to its environment.

2. *Wind Velocity:* The loss of heat is greatest when air is in motion. Brahdy[2] has shown that the following ratio of the number of frost-bites to 10,000 men occurred when these conditions were present. At temperatures below 8°F. regardless of other conditions, the incidence of 5 or more cases could be expected; at temperatures between 8° and 14°F. the incidence of frost-bite was high only when there was strong wind movement; and at temperatures above 24°F. frost-bite rarely occurred, no matter how strong the winds.

3. *Predisposition Because of General Condition:* General body weakness and diseases or conditions which lower resistance, as diabetes, myocarditis, arteriosclerosis and postinfectious asthenia, minimize the protective defenses of the body and increase the susceptibility to frost-bite.

4. *Local Conditions:* Distal parts of the body when deprived of good circulation by virtue of vascular disturbances due either to organic occlusion or to constricting effects of improper clothing, as tight garters, tight shoes, are most sensitive to temperature changes.

5. *Previous Attacks:* Areas once frozen are subject to recurrences. Following exposure to cold complaints are made of sensations of burning or prickling.

The pathology resulting from the action of cold may be due to (1) a reduction of the temperature of the protoplasm, causing a change in colloid structure; (2) ischemia following spasticity of the arteries resulting in gangrene if prolonged; (3) reactionary hyperemia with transudation of serum, compressing the blood vessels and further cutting off the blood supply, and (4) rarely, thrombosis.[3,4,5] The exact cause for the pathological findings may be open to debate in that it may be ascribed to the direct action of cold on the protoplasm or to vasoconstriction. One factor

is conceded, that there is a change in the blood supply.

As mentioned, frost-bite appears in three stages of severity. The first stage is characterized by simple freezing with erythema. The part exposed becomes reddened and severe burning and prickling sensations result followed by vasoconstriction and anesthesia. This anesthesia is dangerous because continued exposure may further damage the part, unknown to the patient. If exposure is terminated early there follows an intense reddening associated with itching, prickly sensations and swelling. From this stage either recovery will follow or chilblains develop. The latter are characterized by bluish red, flat swellings or nodular elevations surrounded by a red zone.

The second stage is identified by the presence of vesicles or bulla on a reddened skin, containing clear fluid which upon breaking may heal or become the site of a stubborn, non-healing ulcer.

The third stage is reached when freezing is prolonged and interference with the circulation is complete. Gangrene is then the inevitable result.

The treatment of frost-bite is threefold; the prophylactic, the surgical and the physiotherapeutic.

Prophylactic: Dry, warm clothing is of the utmost importance. Ear muffs should be used; gloves to keep the hands warm are important; and socks should be well fitting and worn without elastic bands. It is regrettable that the ideal shoes for those exposed to cold have not yet been manufactured. If shoes are waterproof they retain perspiration; if they do permit ventilation they are not waterproof and absorb moisture, which is an excellent conductor. Therefore it can be seen readily that after exposure the feet should be examined and a complete change of footwear, both socks and shoes, be made immediately.

Greasing of the parts should be avoided, inasmuch as grease and oil act as conductors. Working at temperatures below 8°F. and between 8° and 14°F., with strong winds, should be postponed. There should be indoor rests of one-half hour after every two hours of outdoor work under these conditions. Smoking during and after exposure is inadvisable, inasmuch as tobacco causes vasoconstriction, retardation of the blood flow and a consequent drop in the temperature of the parts.[6]

Complaints of numbness and blanching are a danger signal and call for a discontinuance of work.

Those suffering from diabetes, arteriosclerosis, peripheral vascular diseases and general body weaknesses should not expose themselves to extreme degrees of low temperature, since their circulatory efficiency is not up to par and certainly cannot meet abnormal demands.

Surgical: In the treatment of the erythema stage, dry moderate warmth is desirable and is obtained by placing the affected part against the warm areas of the body. Application of too vigorous heat should be carefully avoided for it is conducive to hyperemia which results in the transudation of serum into the soft tissues and the compression of the blood vessels in an area already suffering from a lack of blood supply. Likewise, heat in the form of fomentations should not be used, for there may develop excessive reaction with exudation, blister formation, sloughing sepsis and subsequent moist gangrene.

The rubbing of snow on the affected parts is to be censured.[7] Snow in the city streets is gritty, moist and dirty and the friction may produce abrasions with subsequent infection. Dry, light massage, avoiding abrasions, is of value in restoring the circulation.

If recovery is delayed, the part should be kept warm, dry, elevated and immobilized. The most efficacious way is to wrap the part in dry cotton wool and bandage lightly. If spots of cyanosis, lividity and areas of anesthesia are present after a week, the affected part cannot be expected to recover.[8]

The vesicle stage of frost-bite is treated by opening the blebs under aseptic conditions and applying sterile dressings to the wounds. Stimulating ointments such as desitin, may be used to hasten the healing of the wound. Should the wound fail to heal under treatment by ointments, one may resort to the use of allantoin, whose effectiveness in the therapy of indolent ulcers has recently been reported.[9]

When the frost-bite has reached the stage of gangrene, conservatism and watchful waiting are extremely important. Before recourse to amputation is made, the line of demarcation should be seen. However, if infection intervenes or the gangrene spreads, surgical measures must be instituted promptly. Some have resorted to multiple incisions where the venous circulation is impaired.[10,11]

Physiotherapeutic: The use of diathermy followed by vigorous application of the Oudin current in conditions of chilblains has been effective.[12] For the treatment of the feet and toes, the footplate and cuff-above-the-ankle applications are used, and during the treatment luminous heat is applied for at least one-half hour. The current should produce a comfortable warmth and treatment should be given daily until there is improvement.

Successful treatment of frost-bite with short wave has also been reported.[13]

Good results with local ultraviolet irradiation from the air cooled lamp with the production of a second degree erythema have been reported. The treatments are repeated on the subsidence of the reaction.[14,15]

Galvanic baths at a strength of from 15 to 20 milliamperes have also been used.[16]

Recent reports on the use of the passive vascular exercise machine emphasize its efficacy in preventing the progress of frost bite to its terminal stage of gangrene.[17,18]

CONCLUSIONS

1. Frost-bite is prevalent in temperate climates and can occur at temperatures below 8°F. or between 8° and 14°F. in presence of strong winds.

2. The underlying pathology results in the disturbance of the blood supply to the part, either by destruction of the blood protoplasm or by interference with the circulation.

3. The symptoms may range from a mild erythema through a moderate degree of vesicle formation, to a severe degree terminating in gangrene.

4. Prophylaxis is an important factor in preventing this condition.

5. Conservatism should be displayed in instituting surgical measures.

6. Physiotherapeutic modalities are of proved value.

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AUTOHEMOTRANSFUSION IN PREVENTING POSTOPERATIVE LUNG COMPLICATIONS*

MICHAEL W. METTENLEITER, M.D., F.A.C.S.

Instructor in Surgery, New York Post-Graduate Hospital Medical School and Hospital

NEW YORK

THE administration of blood as a therapeutic agent is a very old procedure, and in primary anemic cases where the replacement of substance plays the main role, is, of course, well known. The application we have in mind is the withdrawal of a small amount of blood from the patient's vein and reinjection directly into the body.

In 1898, Grafstrom and Elfstrom[1] applied autotransfusion in a case of pneumonia. Ten years later Balfour[2] used this method as a specific therapy. All authors employed it purely empirically without explanation of its action. In 1913 autohemotherapy was advocated by Spiethoff[3] in dermatology and considered an unspecific protein therapy. Autohemotherapy has since been used extensively in a variety of diseases and conditions. The results were encouraging in postoperative pneumonia, furunculosis, bronchitis, eczemas and urticaria.

A good result in postoperative lung complications is manifested by the decline of temperature within twenty-four to forty-eight hours after administration and disappearance of symptoms.

There are five different methods of application:

1. Intramuscular injection of defibrinated blood; 20 c.c. of blood is defibrinated by shaking in a flask with glassbeads and injected immediately.

2. Intramuscular injection of 16 c.c. of fresh blood mixed with 4 c.c. of distilled water.

3. Intramuscular injection of unaltered fresh blood.

4. Intravenous injection of defibrinated fresh blood or blood kept on ice for several hours or even days.

5. Intradermal injection of small quantities 1 to 2 c.c., of fresh blood.

The intravenous injection occasionally produces tinnitus, palpitation or other shock symptoms, therefore intramuscular application is preferable. As much as 40 c.c. can be injected intramuscularly without technical difficulties or discomfort to the patient.

Although autohemotherapy was formerly used empirically, we now have a clear explanation for its action.

The rough constituents of blood serum and the subtle changes of the various proteins and derivatives have been brought to light in recent years. Benhold[4] claims that the various albumins, globulins, pseudoglobulins and euglobulins possess physiochemical properties permitting various graduations from one to the other but still retaining their separate specific functions. When blood is employed outside its natural place in the circulatory system it becomes quite a different substance for the body. Its physical chemistry is changed immediately after withdrawal from a blood vessel.

The stimulating effect of parenteral proteins on the sympathetic and parasympathetic system is demonstrated by the following simple test: when defibrinated blood is injected intravenously it immediately produces dilatation of the blood vessel and redness of the skin, peripheral from the point of injection. This redness changes later to a bluish discoloration.

* Based upon 300 private surgical operations.

The general effects upon the autonomic nervous system are even more striking. After the injection of defibrinated blood, vascular reactions combined with reactions of the respective tissues occur all over the body.

Widal and several others[5] observed a marked decrease in the number of leucocytes in the entire peripheral vascular system. Muller and Petersen[6] demonstrated later that this peripheral decrease corresponds to an increase of these cells in the abdominal organs. With this increase in the number of leucocytes in the abdominal organs there is a corresponding increase of the tissue functions, particularly the liver, accelerating the bile secretion and the detoxication procedures.[7]

It seems evident that these reactions depend upon sympathetic or parasympathetic stimulations initiated by the injection of defibrinated blood. This also occurs with other proteins. No effect upon the vasomotoric system, blood or tissues takes place after injection where the autonomic nerve supply of the respective organs is severed.

The reticulo-endothelial system is also definitely stimulated by autohemotherapy. Recent investigations give a well founded explanation for this effect. (Schurer.[8])

There is a simple method for testing the effect of stimulating subcutaneous tissues and cells of vascular walls. A cantharidenplaster, 1 sq. cm. in size, is applied on the thigh for twenty-four hours. A vesicle which formed is opened. The fluid is evacuated and brought into a "U" tube and centrifuged. The sediment is air dried, stained and a differential white blood count is done. (Kauffman.) The normal monocytes incidence is about 5 per cent. After an autohemotransfusion the monocytes in the differential count increase to 22 per cent in eight hours and 20 per cent are still present after seventy-two hours. The curve drops gradually within seven days and returns to normal after several weeks.

The reticulo-endothelial system is also able to store dyes. Colorimetric determination with Kongored (Schurer[8]) revealed a greater reserve after autohemotransfusion. Another test utilizes a bactericidal index after Wright's method. After injection the index shows an increase in a few hours and after eight hours reaches a maximum of 15 to 20 times normal. Like the increase in monocytes, the changes in the bactericidal index prove the stimulation of the defensive powers of the organism, resulting in higher body resistance.

Schurer's investigations suggest that the absorption of the injected blood starts rather quickly. We know that the absorption of milk, novoprotein and other protein substances can be demonstrated after four to six hours.[9] Blood is absorbed after one hour in sufficient quantity to produce the ferment called glycyltryptophanase in the blood stream.

Stimulation of the blood forming tissues in the bone marrow has also been definitely recognized after intramuscular injections of blood or other foreign proteins. Hoff[9] and several others could demonstrate this important symptom as a part of the therapeutic value of protein therapy.

These conclusions point to the wisdom of autohemotransfusion immediately after operation in an effort to prevent postoperative lung complications.

We have used autohemotransfusion in a series of 300 surgical cases, injecting 20 c.c. fresh blood intramuscularly immediately after operation. No lung complications, as postoperative bronchitis or pneumonia, were observed. Only one case developed a small thrombotic area in one lung five days after operation. The operations performed were gastroenterostomies, cholecystectomies, appendectomies, hysterectomies, ovariotomies, herniotomies, thyroidectomies, mastectomies, etc., under general anesthesia with gas and ether, avertin as base and local anesthesia. Postoperative complications may arise with any kind or method of anesthesia, but the absence of lung involvements in our series indicates that autohemotherapy

and not the type of anesthesia applied accounted for the good results.

There is sometimes a negligible amount of blood left in the wound, and it has been suggested that the absorption of this blood may render an additional autotransfusion unnecessary. The physiochemical changes in the whole blood and in the serum are so delicate and occur so rapidly that no comparison can be made between blood drawn from a vein and reinjected intramuscularly and blood left in a wound to be absorbed. These two processes are entirely different.

CONCLUSION

1. The intramuscular administration of 20 c.c. of autogenous blood after operation has a stimulating effect upon the reticuloendothelial system and the sympathetic nervous system which in turn increases activity and resistance of tissues.

2. The method is without danger. This procedure has been used in 300 cases with good results in the prevention of postoperative lung complications and possibly less frequent occurrence of postoperative embolism.

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APPLICATION OF ADHESIVE PLASTER

GUSTAV ZECHEL, M.D., F.A.C.S.

Assistant Professor of Anatomy and Associate in Surgery, College of Medicine, University of Illinois, Chicago, Illinois

CHICAGO

THE first efforts to remove a strip of adhesive from the skin of a patient are usually futile because its ends adhere too tightly to the underlying skin. The result is usually an embarassing moment for both the physician and the patient; the former is annoyed by his helplessness to grasp the end of the condemned adhesive, while the latter experiences the unpleasing sensation of being scratched just above a tender area by finger nails or the tips of instruments (A in Fig. 1). This can be avoided by the following preventive measure, employed at the time of applying the adhesive. Each end of the strip is doubled about ½ an inch so that the sticking surface is bent inward and pressed together. Thus the end of the adhesive is deprived of its capacity to adhere and can easily be grasped. It is obvious that the attempt to remove such a strip thus treated will cause no difficulties, as illustrated in B.

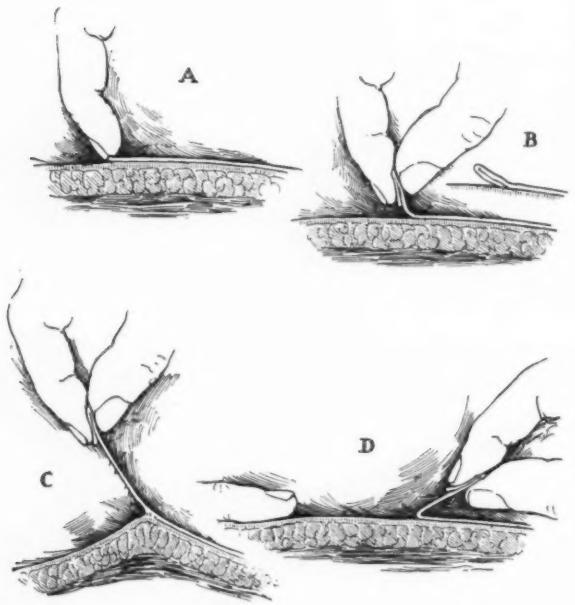

FIG. 1.

Another factor usually neglected in removing the adhesive is the direction of the force applied to the free end of the adhesive. The adhesive should never be pulled in a vertical direction, as is usually done when dressing a patient (C). The angle should be about 135°, and one hand should simultaneously stretch the skin in the opposite direction (D). This obviates the unpleasant sensation of painful pinching which occurs when the adhesive is removed at a right angle and consequently pulls up the skin greatly.

It is obvious that lanugo hairs, scarcely noticeable under ordinary conditions, prove themselves an annoyance when their shaving did not precede the application of the adhesive.

CASE REPORTS

APPENDICITIS COMPLICATING PREGNANCY AND LABOR

JAMES F. NORTON, M.D., F.A.C.S. AND JOHN N. CONNELL, M.D., F.A.C.S.

From the Margaret Hague Maternity Hospital

JERSEY CITY, N. J.

THE occurrence of appendicitis during pregnancy, surgically considered, differs in no respects from appendicitis at any other time and reports of isolated cases or small groups of cases are neither interesting nor unusual, and add nothing to our knowledge. It is obvious, of course, that no obstetrical problem is involved when pregnancy in its early stages is complicated by appendicitis.

A case of acute appendicitis with peritonitis, complicating the first stage of labor, prompted us to review the problems of appendicitis as it occurred in 20,000 consecutive deliveries at the Margaret Hague Maternity Hospital. In going over the recent literature we were impressed by several facts:

(1) The paucity of reports emanating from the larger American obstetrical clinics. (2) the relative infrequency of appendicitis in the last trimester of pregnancy, and the grave prognosis accompanying the complication at this time; (3) the much rarer complication of appendicitis occurring during labor and the increasingly grave prognosis; (4) finally, the marked divergence of opinion as to what constitutes the optimum type of obstetrical procedure, particularly if the patient is at term, and more so, if labor has been initiated.

We feel that our experience with this subject, admittedly limited, is worth recording, and assume this to be sufficient warrant for this presentation.

We wish to present in Table 1 a study of all the cases of appendicitis complicating pregnancy, for we feel that, while it may show nothing new, it does present some interesting features.

Table 1 shows 8 cases of appendicitis complicating pregnancy, all in patients thirty years of age or younger; 4 occurred in primigravida, and 4 in multigravida.

The large proportion occurring during the eighth and ninth months of pregnancy, 4 cases, or half the total, is interesting, as this is contrary to the experience of most contributors, who seem uniformly of the opinion that the greatest percentages are in the early months of pregnancy.

Maes,[1] reporting 50 cases from the Charity Hospital in New Orleans, says that the majority occur in the second trimester; Royston and Fisher,[2] presenting a series of 10 cases, show none of the acute type later than the sixth month; Landry[3] says it is much more frequent in the third and fourth months and further adds that during the last two months the problem is a gigantic one.

Heineck[4] made an analytical study of all operated cases of appendicitis associated with gestation reported in the English, French and German literature from 1916 to 1926. His statistics include those cases presented by Jerlov, in 1925, who has had an extensive experience and has written a very comprehensive monograph dealing with appendicitis in pregnancy and the puerperium gathered from Scandinavian sources from 1900 to 1920. From this vast amount of material, Heineck states that the complication is most frequent in the

second, third and fourth months, and is rare in the last few weeks. Marbury[5] says that 80 per cent are in the first six months. D'Erico,[6] reporting 65 cases from various Boston hospitals, shows 4 cases occurring during the last month. Wilson,[7] presenting 10 cases from the obstetrical and surgical services of the Methodist Episcopal Hospital in Brooklyn, had 3 cases in the last trimester.

first evidence of upward displacement of the appendix by the gravid uterus which is found after the third month, and the increased incidence of appendicitis occurring during the second trimester.

From a pathological viewpoint, except for the ruptured gangrenous appendix complicating labor, there did not seem to be any predilection for the severer types of appendiceal involvement to occur late in

TABLE I

Case	Name and Number	Age	G	P	L. M. P.	Date of Operation	E. D. C.	Month of Pregnancy	Pathological Diagnosis
I	J. B. 8404	20	I	0	6/ ?/32	2/14/33	3/ ?/33	8th	Acute gangrenous appendicitis
II	T. D. 8382	28	IV	III	7/20/32	4/12/33	4/27/33	9th	Acute purulent appendicitis
III	A. K. 13604	27	III	II	12/28/32	5/ 9/33	10/ 5/33	5th	Acute gangrenous appendicitis
IV	V. D. 12726	30	II	0	12/ 4/32	5/24/33	9/11/33	6th	Acute gangrenous appendicitis
V	E. H. 16179	18	I	0	10/ 9/33	2/ 9/34	7/16/34	4th	Acute purulent appendicitis
VI	H. O. B. 17672	26	II	I	11/30/33	4/10/34	9/ 8/34	5th	Chronic appendicitis
VII	E. T. 20669	23	I	0	5/15/34	1/ 3/35	2/22/35	8th	Chronic appendicitis, subsiding acute
VIII	J. H. 19680	18	I	0	3/21/34	12/21/34	12/28/34	9th	Ruptured gangrenous appendicitis

DeLee,[8] reporting 2 cases which bring to 4 his total of cases observed in thirty years, says "In the last few weeks of gestation and during labor, it is very rare."

Schmid,[9] whose series is one of the largest reported in the literature, reports the majority of his 486 cases as occurring between the third and sixth months of pregnancy, and mentions only 21 cases as occurring at the end of pregnancy.

LeJemtel[10] finds appendicitis to be a complication found mostly in the first half of pregnancy.

Baer[11] et al. report, from the Michael Reese Hospital in Chicago, 28 cases of appendicitis occurring as a complication of pregnancy; 14 patients of this group were operated during the second trimester of pregnancy, 8 during the first trimester, and 6 during the third trimester. They indicate a causal relationship between the

pregnancy, as many believe. As indicated in the table, the case at four months was an acute purulent appendicitis, and one at the fifth and another at the sixth month acute gangrenous appendicitis; 1 case at the eighth month had an acute gangrenous appendicitis; another at the ninth month had acute purulent appendicitis. There were 2 cases of chronic appendicitis, 1 at the fifth, and another at the eighth month.

In none of these cases, excepting the one complicating labor, was any difficulty encountered at operation with the pregnant uterus. No attempt was made in any way to interfere with the progress of pregnancy. These cases offered no special difficulty in diagnosis or surgical or obstetrical management, and in each an appendectomy was performed and drainage used when indicated; the postoperative course of all the cases paralleled that of any case with

appendix and peritoneum similarly involved. None of the early cases aborted and none went into premature labor.

The subsequent obstetrical record of these 8 cases is shown in Table II.

Of the 4 cases in the last trimester, Case I was delivered two days after operation by elective low forceps under spinal anesthesia, and about fourteen days before term.

Table II

Case No.	Date of Operation	Date of Delivery	Relation of Delivery to Operation	Type of Delivery and Anesthesia	Days Morbid Postpartum	Condition on Discharge	
						Mother	Child
I	2/14/33	2/16/33	2 days P. O.	Elective low forceps. Spinal	None	Good	Good
II	4/12/33	4/27/33	15 days P. O.	Normal spontaneous delivery	6	Good	Good
III	5/ 9/33	10/13/33	157 days P. O.	Elective low forceps. Spinal	None	Good	Good
IV	5/24/33	8/ 8/33	76 days P. O.	Normal delivery	None	Good	Good
V	2/ 9/34	7/24/34	165 days P. O.	Normal delivery	None	Good	Good
VI	4/10/34	9/ 3/34	146 days P. O.	Normal delivery	None	Good	Good
VII	1/ 3/35	1/23/35	21 days P. O.	Elective low forceps. Ether	None	Good	Good
VIII	12/21/34	12/22/34	1 day P. O.	Elective low forceps. Ether	5	Good	Good

From Table II it will be seen that we have adopted an attitude of prompt surgical intervention toward appendicitis complicating pregnancy, but have refrained from interfering with the pregnancy in the absence of any definite obstetrical indication. In none of these cases was any accouchement force, bagging, induction of labor or interference of any nature practiced either before, at the time of, or after operation.

It is interesting to note that the morbidity course following the onset of labor was not unusual, considering the pathology of the appendix, even in the cases going into labor on the first and second days after operation. This, it seems, at least holds up to question the position of those operators who claim that, unless the uterus is emptied either before or at the time of the appendicectomy, the uterine activity incident to labor will enhance the spread and diffusion of the peritoneal infection. In none of the cases seen early in pregnancy did abortion or premature labor supervene. All went to term.

Case II was delivered fifteen days after operation by normal spontaneous delivery, ether anesthesia, on her expected date of confinement.

Twenty-one days after operation Case VII was delivered by elective low forceps, ether anesthesia, about four weeks before her expected date of confinement.

Case VIII was delivered by elective low forceps under ether anesthesia one day after operation and was in labor before the operation was begun.

There were no maternal or fetal deaths in this series of 8 cases.

Because of the extreme rarity of gangrenous appendicitis with diffuse peritonitis complicating labor, we submit some statistics from the recent literature.

Table III shows a total of 1110 cases of appendicitis complicating pregnancy, with only 9 cases occurring in labor. The incidence is very difficult to estimate accurately from these series, because one has no way of determining from how many cases of pregnancy these cases were drawn.

TABLE III

Author	Source of Cases	No. of Cases during Pregnancy	No. of Cases during Labor
Schmid[9]	Collected from literature for 20 years prior to 1911 plus 28 cases of his own.	486	0
Heineck[4]	All cases in English, French and German literature 1916–1926.	405	2
Jerlov[12]	Scandinavian hospitals from 1900–1920.	Included in Heineck series	0
D'Errico[6]	Various Boston hospitals.	65	0
Maes[1]	Charity Hospital, New Orleans	50	0
McDonald[13]	Western Surgical Ass'n.	33	0
Baer, Reis[11] and Arens.	Michael Reese Hospital, Chicago, Ill.	28	0
Wilson[7]	Obstetrical and surgical services, Methodist Episcopal Hospital, Brooklyn, N. Y.	10	0
Royston and Fisher[2]	Personal series	10	0
Findley[14,15]	Personal series	9	0
Portes and Seguy[16]	Personal series	7	0
Puppel[17]	Personal series	6	1
Barber and Miller[18]	Personal case	.....	1
Grattan[19]	Personal case	.....	1
King[20]	Personal case	.....	1
Krauss[21]	Personal case	.....	1
Le Jemtel[10]	Personal case	.....	1
Marbury[5]	Personal case	1	
Rose[22]	Personal case		1

From this table it is quite evident that there is no lack of statistical reports relating to appendicitis as a complication of pregnancy, and further, that the complication is not unusual. But one must be impressed by these figures, which indicate a total of 1110 cases of appendicitis during pregnancy and only 9 during labor.

The largest series are those by Schmid,[9] Heineck,[4] and Jerlov.[12] In presenting his group, Schmid,[9] from a very detailed study of 486 cases, shows none as complicating labor. Heineck,[4] indicates 2 cases during labor, and while he discusses appendicitis as it occurs within several days of term, he does not go into any great detail concerning appendicitis as a complication of labor. Jarlov,[12] in his report, does not indicate any of his cases as occurring in labor.

Throughout the entire literature on this subject, repeated reference is made to the statement by DeLee,[8] that in thirty years he has seen but 4 cases of appendicitis late in pregnancy.

The incidence of appendicitis with peritonitis complicating labor in our series is 1 in 20,000.

CASE HISTORY

J. H., a primigravida clinic patient, aged nineteen years, entered the hospital at 5:55 P.M. Dec. 20, 1934, in labor which had started at 1:00 A.M. The pains increased in severity throughout the day. Just before entering the hospital, the pains were severe and occurred every five minutes. She had been seen at the prenatal clinic five times, had a normal pregnancy which had progressed uneventfully; her pelvic measurements were normal.

At 7:37 P.M. the fetal heart was of good quality, heard in the right lower quadrant; the vertex was in the brim, the cervix 3 cm. dilated and thinned, with membranes intact.

At 11:00 P.M. it was noticed that, although the patient was a young primigravida and somewhat emotionally unstable, she was having pain out of proportion to the stage of labor. In addition, she was vomiting and looked sick. A note was made on the labor record that the patient complained of pain in the right side. The pain was fairly well localized in the upper part of the right lower quadrant, and the abdomen was tender over the entire right side. It was felt that an acute inflammatory condition within the abdomen had to be considered.

When seen at 12:10 A.M., she presented the following picture: she had continuous generalized abdominal pain, which was accentuated with each uterine contraction, but most severe on the right side. She was nauseated, retched frequently, was very restless, nervous, and unable to cooperate well. Her tongue and lips were dry, temperature was 101, pulse 100 of good quality. The uterine contractions occurred every three to four minutes. On palpation of the abdomen between uterine contractions, very pronounced tenderness and rigidity were found in the right flank at and above the crest of the ilium. Tenderness was also present in the right upper quadrant and left lower quadrant. The rectal examination showed the cervix to be 6 cm. dilated, with the vertex 1.5 cm. above the spines in an R.O.A. position. There was no vaginal bleeding. A catheterized specimen of urine was negative.

The white blood count was 26,600 with 90 per cent polymorphonuclear leucocytes.

The preoperative diagnosis was acute appendicitis with rupture and peritonitis. Operation was done under spinal anesthesia supplemented with ether, after 1500 c.c. of normal saline had been given by clysis.

A 16 cm. right rectus incision was made, higher and more lateral than usual because of the higher location of the appendix as pregnancy approaches term. The muscle was retracted mesially, and the posterior sheath of the rectus and peritoneum was opened. Free purulent fluid welling into the wound was suctioned. There immediately presented a cyst of the right ovary, $10 \times 8.5 \times 6$ cm. in size, twisted twice upon its pedicle which was excised. Pus continued to issue down the right lumbar gutter, and we appreciated that the cyst was but an incidental factor and not the source of trouble. The cecum was located high above the crest of the ilium and the incision had to be extended upward. It required a few minutes search to find the appendix, which had rotated counter-clockwise and was under the liver. The appendix was excised with some difficulty due to its location and bulk of the gravid uterus. Two soft rubber drains were placed, and the abdomen was closed in layers.

The postoperative orders were high Fowler positions, nothing by mouth for forty-eight hours, clyses of 1500 c.c. of 5 per cent glucose and saline every eight hours. Morphine grains $\frac{1}{6}$ hypodermically were repeated every four hours.

Postoperative course: At 12:30 A.M., Dec. 22, after twenty-four hours arrest, labor was suddenly resumed and progressed rapidly. At 2:10 A.M., twenty-four hours after operation, under ether anesthesia an elective low forceps delivery was done with a left mediolateral episiotomy. The baby was narcotized and required the usual artificial help to initiate respiration. The subsequent course of the mother and baby was uneventful and both were discharged from the hospital on the twenty-fourth day after the operation.

Pathological Report: Right Ovary. The gross specimen consists of a round ovary weighing 210 Gms., measuring $10 \times 85 \times 6$ cm. On cross section some clear viscous fluid is discharged. The outer cavity is smooth, pale and skin like; the inner lining is smooth, except where a round nodule 1 cm. in diameter is seen. On cross section, some sebaceous material with dark hair is expressed. The wall in one place measures 0.5 mm., and in other places 2 mm., in thickness.

Microscopical sections of this wall show a lining of high cylindrical cells which form papillary projections of similar lining. The cyst is attached directly to the ovary. Sections of the small nodule show skin like coverings, with hair follicles and sebaceous and sweat glands. There is also cartilage and bony tissue.

The microscopical diagnosis was papillary cystadenoma of the ovary, with an epidermoid cyst.

Appendix: The laboratory report gave the diagnosis of acute purulent appendicitis with acute gangrenous exacerbations, and acute fibrinopurulent periappendicitis.

COMMENT

The difficulties encountered in the preoperative diagnosis, were the ruling out of pyelitis and the determination of the probable extent of the peritoneal infection. There was definite general abdominal tenderness most pronounced above the crest of the ilium on the right side and rigidity which also was more marked on the right side. These abdominal findings were distinguished clinically from the intermittent uterine contractions of labor. The patient could, and would, inform us of the onset of a labor pain. The general nature and extent of the abdominal signs were sufficient to warrant the assumption that we were dealing with a ruptured appendix and a diffuse peritonitis. Pyelitis was quite easily eliminated because of the history, type of pain, radiation, abdominal examination, and the urinary findings.

Surgical and Obstetrical Management: It was deemed wisest to perform an appendectomy with drainage and to leave the pregnant uterus alone; to attempt putting the patient out of labor with morphine and to hope for a vaginal delivery at a later date.

We did not feel that opening the uterus transperitoneally in the presence of a frank and free peritoneal infection was either wise or justified. The finding of the ovarian

cyst with the twisted pedicle offered no serious problem. A Porro section was decided against because of the age of the patient, nineteen years. We accordingly made a right rectus incision, although higher and more lateral than usual proved later to be both too low and too mesial. The free pus was drained by suction from the abdominal and pelvic cavities, the right cystic ovary and the ruptured gangrenous appendix were removed and drains inserted. Closure was made in the usual manner.

We present in Table IV the details of the cases we were able to find in the recent literature of appendicitis complicating labor, and do so to emphasize the divergent methods utilized in the obstetrical management of these cases. King thinks the uterus should be emptied first, to reduce its size and get away from its bulky interference; he also feels that premature labor is very likely to follow operation, and the activity of the uterus is likely to do much towards breaking down protective adhesions and giving rise to widespread infection. He thinks, too,

TABLE IV

Author	Anesthesia Operation	Pathology	Method of Delivery	Delivery Hours Before or After Operation	Result	
					Mother	Child
Heineck.....	Appendectomy	Ruptured appendix	Normal spontaneous delivery of non viable child	Delivered before operation	?	Died
Heineck.....	Appendectomy	Pre-perforative stage of gangrene	Normal spontaneous delivery	9 hours after operation	L.	L.
Barber, and Miller.	Gas, oxygen ether; Appendectomy	Acute appendicitis (mild)	Breech extraction	18 hours after operation	L.	L.
Grattan.....	Chloroform; Appendectomy	Acute gangrenous appendicitis; beginning peritonitis	Chloroform; low forceps	9 hours after operation	L.	Died 7½ hrs. P. P.
King.....	Spinal; Appendectomy	Retrocecal, gangrenous perforation	Cesarean section	Section immediately preceded appendectomy	L.	L.
Rose[22].....	Gas, ether; Appendectomy	Acute peritonitis	Normal spontaneous delivery	Delivery immediately preceding appendectomy	L.	L.
Krause.....	Appendectomy	Acute appendicitis; abdomen filled with purulent exudate	Normal spontaneous delivery	6 hours after operation	L.	L.
McDonald...	Ethylene; Appendectomy	Gangrenous appendicitis; free purulent fluid	Cervix dilated manually; version and extraction	Before operation	L.	L.
Finlley.....	No operation performed	.....	Normal spontaneous delivery	An attack of acute appendicitis during labor without operation	L.	L.
Lè Jemtel....	Appendectomy	Ruptured appendix; pus in peritoneal cavity—abundant	Manual dilatation of cervix, then forceps	3 hours after operation	L.	L.
Puppel.....	Peritonitis, appendicitis	Delivery by "expression"	48 hours before operation	Mother died		

that there is likelihood of infection of the placental site through the bloodstream.

McDonald, writing of a case with impending labor, under ethylene anesthesia manually dilated the cervix, and delivered by version and extraction a full term living child. He then followed this by opening the abdomen and performing an appendicectomy.

Barber and Miller operated for the appendicitis at term and interfered in no way with the pregnancy. They gave liberal doses of pantopon in the hope of deferring labor. The opiate did not have any effect on labor except to give the patient a very comfortable first stage. Eighteen hours after operation, a breech extraction was performed.

Grattan's case was first operated for an acute gangrenous appendicitis, and then nine hours after operation was delivered by low forceps under chloroform anaesthesia.

Krauss, in writing of a case with acute appendicitis and an abdomen filled with cloudy purulent exudate and the patient in labor, first performed an appendectomy and in no way interfered with the pregnant uterus. Six hours after operation a normal spontaneous delivery ensued through the birth canal. He says in his discussion that in accordance with the practice of Portes and Seguy (Paris) he always treats the appendicitis and delivery in two separate procedures, following the principles usually applied to each.

Rose,[22] had a case where labor was completed normally, and then immediately after delivery, the abdomen opened and an acute appendix removed.

Rose,[23] presenting a case with an old appendiceal abscess in the last trimester of pregnancy, says that in the presence of a ruptured appendix and pus formation, the consensus of opinion is that it is best to remove the appendix and do a Porro section at the same time.

Many commentators, while presenting no case complicating labor, express themselves quite definitely. According to Maes, "Prompt operation is indicated as soon as the diagnosis is made, or reasonably suspected, and the procedure should be conducted throughout on the basis of sound surgical principals and delivery should be according to obstetric indication."

D'Errico[6] regards the complication of labor following operation as a bad prognostic sign. In all 4 fatal cases in his series, labor followed the operation.

He asks the question "What shall be the conduct in primipara in labor with a ruptured appendix with diffuse peritonitis?" He quotes Jerlov[12] in answer, "There is no indication to perform a hysterectomy in cases complicated by peritonitis . . . the uterus should not be emptied routinely after operation . . . the best results are obtained by waiting for a spontaneous delivery."

Baer et al[11] says, "There is only one treatment for appendicitis; viz. prompt surgical removal regardless of the pregnancy. The pregnancy on the other hand should be left undisturbed regardless of the severity of the appendiceal involvement or the advanced state of the pregnancy." This statement epitomizes our attitude.

From these references one readily appreciates that all who have written on the subject of appendicitis complicating labor stress the complexity of the problem and emphasize the difficulty of a proper interrelationship of the surgical and obstetrical management. This complication is so rare (in our series 1 in 20,000) that it is hardly likely that any one observer will ever see very many cases, and so one cannot point to any large or reasonably extensive personal experience in dealing with it. However, we do feel that sight of good, sound obstetrical practice should not be lost, and we accordingly do not approve of *accouchement forcé*, or the transperitoneal invasion of the uterus through a peritoneal cavity abounding in free pus, if delivery from below can be expected.

A fear expressed by many is that if the uterus is not emptied immediately, the protective barriers which enter to limit the peritoneal extension of the infection will

surely be disrupted when labor does start and a subsequent spread of infection will take place throughout the abdominal cavity. In the cases reported by Barber and Miller, Grattan, Heineck, and Krauss, this apparently did not occur, neither did it happen in our case.

We feel that in the absence of a true obstetrical indication demanding a different attitude, suppurative appendicitis with peritonitis during labor should be regarded as a complication to be handled as at any other time and the labor allowed to continue, with delivery through the birth canal.

SUMMARY

1. Eight cases of appendicitis complicating pregnancy in 20,000 deliveries are reviewed. Of these, 6 were definitely acute.

2. Four occurred in the last month of pregnancy; one was an acute gangrenous appendicitis with perforation and peritonitis complicating labor.

3. With the exception of this one, no unusual difficulty was encountered at operation because of the pregnant uterus, with which there was no interference.

4. None of the early cases aborted or went into premature labor.

5. The morbidity course following labor and delivery was not unusual, nor was peritoneal involvement increased.

6. A case of acute gangrenous appendicitis with perforation and peritonitis complicating labor is presented, with the usual delay in diagnosis experienced.

7. The cecum was located above the crest of the ilium and the appendix had rotated counter-clockwise under the liver, confirming observations by Baer, Reis, and Arens on the location and rotation of the appendix and cecum as they approached term.

CONCLUSION

Acute appendicitis with peritonitis complicating labor, should be managed surgically as it is at any other time, and the labor allowed to continue with delivery through the birth canal, in the absence of an indication requiring a different obstetrical procedure.

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FAVORABLE EFFECT OF X-RAY ON UNUSUAL BLADDER TUMOR

REPORT OF CASE

JOHN K. ORMOND, M.D., F.A.C.S.

Surgeon-in-Charge, Division of Urology, Henry Ford Hospital

DETROIT

INSTANCES of successful treatment of malignant bladder tumors by deep *x*-ray are sufficiently uncommon to make the following case worthy of report.

The patient was seen in September, 1933. He was seventy-one years old and had always enjoyed good health previous to his present illness. He complained of burning on urination, marked frequency and urgency almost amounting to incontinence. For several years he had been accustomed to void once during the night, but about two months earlier his frequency had suddenly increased so that he was voiding eight or nine times during the night, and every fifteen or twenty minutes during the day, and urination was always accompanied by burning. He dated this access of symptoms from a wrench which he had given his back lifting a wheelbarrow load of gravel.

His urine had always been clear and there had been no hematuria. For about six months he had noticed a swelling at the right pubic crest which disappeared when he lay down. He had lost about twenty-three pounds during the year.

In addition to the urinary symptoms, he had some epigastric distention and nausea, but no vomiting.

A general physical examination showed a well preserved, vigorous elderly man who did not look his age; there was no elevation of temperature or pulse rate; except for pyorrhea no abnormality was noted in the mouth, nose or throat; the heart and lungs were clear to auscultation and percussion; his arteries were thick and tortuous; and his blood pressure was 130/80. The abdomen was somewhat distended but no masses were palpable; the deep reflexes were normally obtained, and the bones and joints showed no gross abnormalities. There was a right inguinal hernia; varicosities in the legs; and a small pedunculated fibroma of the back. The prostate was symmetrically enlarged and its consistency did not suggest carcinoma.

The urine was clear and showed: a specific

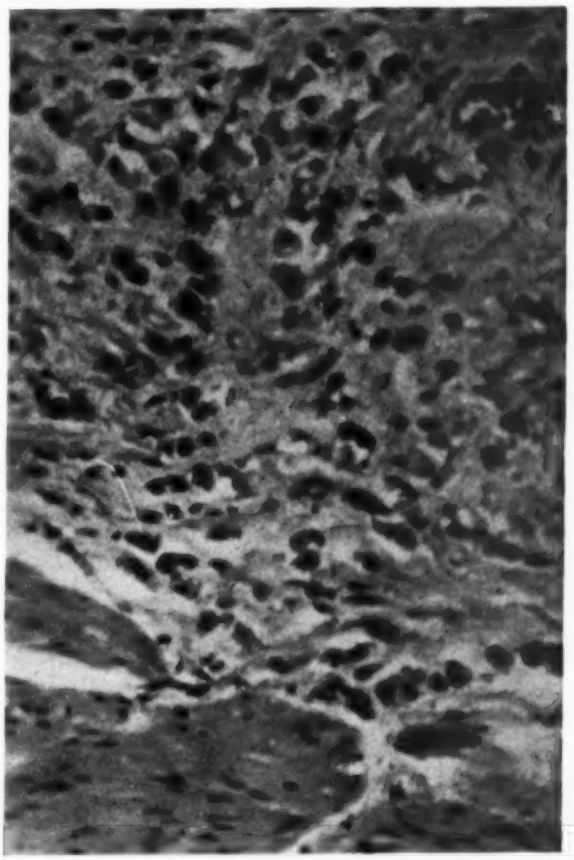

FIG. 1.

gravity of 1.008, positive albumin, no sugar, no blood and very few pus cells. Hemoglobin was 78 per cent, and the leucocyte count was 6400. The blood Wassermann test was negative.

The phenolsulphonaphthalein output was 23 per cent the first hour, and 22 per cent the second; the non-protein nitrogen of the blood was 40.6 mgm. per 100 c.c.

X-rays of the urinary tract showed no shadow suggesting stone.

Catheterization was attempted but the catheter would not enter the bladder. His

urethra was so sensitive that cystoscopy was essayed under general anesthesia. The bladder neck was found to be exceedingly rigid and the capacity of the bladder was so small that a satisfactory examination was not obtained. In fact, the examiner was not sure that the instrument was in the bladder.

Suprapubic cystotomy was done. In the place of the bladder a firm mass was found; so, in order that a satisfactory exploration of the pelvis might be made, the peritoneal cavity was opened. It was found that this mass was the bladder, which was firm, almost hard and shrunken in size. With the radioknife, a circular incision was made suprapubically into this mass, and carried down through the mucous membrane, thus removing a cylinder of tissue. The bladder wall was about 1½ inches thick, inelastic and very firm. The mucous membrane seemed normal and was not ulcerated anywhere, but the capacity of the bladder was reduced to a few cubic centimeters which probably explained the unsatisfactory nature of the cystoscopic examination.

A Pezzer catheter was then inserted into the bladder and the wound closed about it.

Dr. Hartman's report on the microscopic sections of the tissue removed was as follows: "Sections taken from the wall of the bladder show diffuse infiltration by large epithelial cells. These have abundant cytoplasm and large hyperchromatic nucleoli. The infiltration is always diffuse and there is an excess of sparsely nucleated, pink staining hyaline stroma. There is no suggestion of gland formation and nothing that determines definitely whether this is a primary or metastatic carcinoma. Impression: Scirrhus Carcinoma."

A careful examination, including gastrointestinal *x*-rays, was made for evidence of carcinoma elsewhere but none was found.

He was given four deep *x*-ray treatments through different portals. A gloomy prognosis was given to his relatives; and he was sent home with suprapubic drainage.

However, after he returned home, the suprapubic wound closed, his bladder capacity increased greatly, so that there was no great urinary frequency; his weight increased somewhat and he resumed all his former activities. At the last report, August 1, 1935, he was perfectly well, active and busy; nocturia only once each night and not troubled by excessive day frequency.

This is assuredly a most pleasing result. Of course, two years is too short a period to warrant claims of cure, but he has had two years of comfortable life.

And our confidence in the efficacy of *x*-ray therapy in the case of bladder tumors has received a fillip.

A photomicrograph of the microscopic section accompanies this report.

SUMMARY

An unusual kind of bladder tumor, infiltrating the whole bladder wall, was treated by deep *x*-ray with brilliant results. The patient was apparently in perfect health two years later.

LEUKOPLAKIA OF KIDNEY PELVIS AND URETER*

WILLIAM N. TAYLOR, M.D.

COLUMBUS, OHIO

LEUKOPLAKIA of the urinary tract is most often encountered in the bladder, is rare in the kidney pelvis, and is less frequently encountered as a distinct entity in the ureter. The rarity with which it occurs in the kidney pelvis and its unknown etiology make it desirable that all cases be reported in order that data may be accumulated which will eventually throw light upon the unknown factors and possibilities of the disease as well as aid in the early diagnosis and therapy of it. Histologically, the lesion is particularly interesting because it is an ectodermal process existing in tissues that are embryologically mesodermal and entodermal in origin. This phase of the subject accounts for many ingenious theories and conjectures that have been given to explain the occurrence of such a paradox. Clinically, it is a benign lesion. Its importance, however, is increased as evidence accumulates to show that it may play an important part in the development of squamous cell carcinoma in the urinary tract.

We were stimulated to investigate the interesting phases of this subject after encountering the following case.

CASE REPORT

W. F., white male, age thirty-six years, an automobile mechanic was admitted to the University Hospital, December 11, 1933, complaining of frequency of urination, bloody urine and pain in the left kidney region. Frequency of urination began in 1916. It started as a day and night frequency without any other discomfort. It gradually increased in severity for about one year, when burning during urination and terminal pain became prominent. In 1918, he suffered his first attack of left ureteral colic. His urine showed microscopic blood. An *x*-ray picture revealed a shadow in the left kidney region. He suffered from attacks of ureteral colic of varying intensity from 1918 to 1920. Gross bleeding and severe colic continued intermittently until 1922; at that time he entered a large clinic where he was carefully studied for tuberculosis of the kidney. Being discharged without a definite diagnosis, he was informed that they strongly suspected tuberculosis of the left kidney. Frequency of urination, an occasional ureteral colic and moderate intermittent hematuria continued to be prominent symptoms for the following five years.

He entered another clinic in 1927, where he was carefully studied but no diagnosis was made. While there he had his appendix and a left varicocele removed. During the summer of 1930 and 1931, he carried gross blood in the urine constantly for a period of two months. In 1932, he passed a soft concretion. Following which, his bleeding ceased and his bladder symptoms improved. After the stone passed, he noticed that his urine was a dirty milk color, which has been observed many times since. Eight months before he entered the hospital, he noted a marked increase in urinary frequency; hematuria and pain in the left kidney region were more severe and practically constant. The pain radiated into the left groin, testicle and penis. The attacks of pain occurred most frequently at night after retiring. Chills, fever and sweating have been variable symptoms, but they were particularly aggravating during the last two months. Notwithstanding the fact that this man had had marked freqeuncy, dysuria, hematuria and repeated attacks of colic over a period of fourteen years, he has continued to work, except during attacks of pain. He was in a fairly good state of nutrition and had maintained his weight.

The only previous illnesses he had suffered worthy of note were a bilateral otitis media when a child, gonorrhea in 1914, two years before his present trouble began, measles in

* From Urological Department, Ohio State University. Read before the Columbus Academy of Medicine, April 2, 1934.

1919 and influenza in 1920. He denied a primary sore.

Physical examination revealed a well developed, white male, 5 feet, 8 inches, in height. He appeared anemic. There was a deviation of the nasal septum to the right, and enlarged turbinate bones which occluded the nares. His ears were normal; his teeth were in good condition; the tongue and buccal cavity were normal; his throat slightly injected; the chest was negative on all examinations; heart was normal with the exception of soft systolic murmur at the apex; blood pressure was 132/90.

Examination of the abdomen was negative except for tenderness elicited on palpation over the left lower quadrant, the left flank and costovertebral angle. External genitalia were normal; the prostate was small and tender on palpation; the extremities and reflexes were normal.

The urine was alkaline, specific gravity 1.020; albumin ++; no sugar, no casts; pus cells +; red blood cells +++. A stained sediment showed gram negative cocci and much epithelial debris. The phenosulphonephthalein output was 25 per cent the first hour and 15 per cent the second hour. His hemoglobin was 48 per cent, red cells 3,570,000 and white cells 6,800; the blood sedimentation was very rapid. The non-protein-nitrogen was 45 mg. per 100 cc. of blood. The Wassermann and Kahn tests were negative.

Cystoscopic examination revealed a marked diffuse cystitis, a very irritable bladder which contained a large amount of gray flaky material and pus. The right ureteral orifice was injected, the left was "golf hole" and markedly edematous with some superficial ulcerations about it. Both ureters were catheterized easily. The urine from the right kidney was normal. Urine from the left kidney was a dirty milk color, albumen ++, pus cells ++, red blood cells ++. No bacteria were obtained on smear or culture from the right kidney, but gram negative cocci were found in culture and smear from the left kidney. Indigo carmine given intravenously appeared on the right side in two minutes in a concentration of 3; on the left side it appeared in three minutes in a concentration of less than 1.

A flat plate of the urinary tract shows some pale shadows in the left kidney region which were interpretated as areas of calcification in the renal parenchyma. The left pyelogram showed a moderate hydronephrosis with fuzzy borders which entirely included the calcified areas. No ureterogram was obtained.

Our preoperative opinion of this case was that we were dealing with a chronic tuberculosis with marked secondary infection, stone formation or calcification. We probably leaned toward this idea because of the fact that he had spent time in two large clinics where a persistent effort to confirm a clinical diagnosis of tuberculosis failed. The history, with the small irritable bladder, "golf hole" ureter, and a hydronephrosis with a feathery border, was responsible for our preoperative diagnosis of tuberculosis of the kidney, although we were unable to find the tubercle bacillus.

At operation the fatty capsule was small in amount and showed evidence of chronic perirenal infection and was removed with difficulty from the surface of the kidney, which showed evidences of old and new infarcts. It was normal in size, firm in consistency, and much paler than normal. A great deal of difficulty was experienced in freeing the pelvis and ureter from a large amount of chronic inflammatory and edematous fatty tissue. The ureter was encircled throughout with this same tissue. The ureter measured about ¾ inch in diameter. Upon palpation it gave the sensation of a thick, firm, edematous but elastic tube. Palpation did not reveal the induration of an advanced tuberculosis but rather the sensation of palpating a tube of art gum. The upper third of the ureter was removed. The kidney pelvis was dilated and the wall was very thick and elastic. From gross observation of the kidney and ureter, we were still of the opinion that we were dealing with tuberculosis until the kidney was sectioned. The pathologist's (Dr. Harry L. Reinhart) report was as follows: "Grossly the specimen consisted of a kidney and a portion of the ureter. The kidney measured 7 cm. in length and weighed 180 grams. The pelvis of the kidney was moderately dilated, as well as the ureter. A moderate amount of edematous perirenal fat was removed with the kidney. Upon removal of the fat multiple renal infarcts, both old and recent, were noted on the surface of the kidney. Upon sectioning the kidney, there was an irregular yellow stone about 1 cm. in diameter in a calyx of the lower pole, while similar smaller stones were embedded in a dilated purulent calyx of the upper pole. There were multiple smaller

stony particles present throughout the pelvis and calyces. The pelvis was dilated and entirely covered by a membrane which was firmly adherent. (Fig. 1.) The membrane was grayish white, irregular, and rough due to the many folds which it presented. It had an occasional miliary stone embedded in it. It was stripped from its base with difficulty, leaving a red, granular, irregular surface. The minor calyces and renal papillae were entirely free of it, but contained pasty masses of partially organized yellow gritty material. The cortex was pale, markings indistinct, and averaged about 7 mm. in thickness. The medulla was not remarkable. The infarcts noted on the surface were prominent on cut section.

"Microscopically there were multiple infarcts, diffuse fibrosis, lymphocitic infiltration of the kidney and hyaline degeneration of the glomeruli. The mucous membrane of the kidney pelvis showed complete epidermoidization, with keratinization, marked thickening, and active hyperplasia. (Fig. 2.) There were also irregular depositions of calcium in the membrane. There was marked subepithelial infiltration of plasma cells, lymphocytes and eosinophiles upon a granulomatous base. The ureter showed essentially the same pathology as the pelvis. The microscopic diagnosis was: (1) chronic pyelonephritis; (2) multiple infarcts of the kidney, old and recent; (3) leukoplakia of renal pelvis and ureter."

Follow up on this patient shows complete recovery from symptoms. Three cystoscopic examinations show marked bladder improvement and a normal right kidney. At times a few pus cells are found in the urine which may come from the remainder of the ureter, which is involved. He refuses to have it removed.

The disease was first described by Rokitansky[1] in 1861. Lowenson[2] reported a specific case of leukoplakia in the bladder as early as 1861, but it was not until twenty years later that Ebstein[3] reported the disease in the kidney pelvis. The first report to appear in American literature was by Beer[4] in 1914. Excellent presentations on the subject have since been made by Kretschmer,[5] Richey[6] in 1920, Cumming[7] in 1923, Hinman[8] in 1924. In May of 1929, Kutzmann[9] reported a case of leukoplakia of the kidney pelvis, and after a very complete review of the literature, collected 67 cases, including his own. Since his review, 4 cases have been reported. Culver and Baker[10] in 1930; Potts,[11] 1932; Arlotta,[12] 1932; Reynolds and Howard,[13] 1933 each reported a case to bring the total to 71. The author's case makes a total of 72.

Fig. 1. Note irregular white membrane and a mass of the gritty material that surrounded the papilla.

Due to a lack of any specific evidence to explain this remarkable tissue change, various theories have been advanced. Early observers thought it was secondary to constitutional diseases. Thus it was thought at that time that leukoplakia of any mucous membrane probably had a syphilitic background and there were a few cases of leukoplakia of the kidney pelvis reported in which the authors believed that syphilis did play a primary causative role. Local diseases of the kidney and pelvis were at times thought to produce it but it is evident that the common diseases occur entirely too frequently without leukoplakia to assign them as a causative factor in its production; these associated diseases could well be secondary to leukoplakia.

However, it is a significant observation that infection, stone and obstruction have played a prominent role in practically all cases reported. The disease is most often found in a kidney pelvis which has suffered a long standing chronic irritation, and all the theories advanced to explain its causation have one main idea and that is that the process is a protective one on the part of the mucous membrane. The idea that leukoplakia is the result of the mucous membrane trying to protect itself against destruction is suggested by Hinman, Gibson and Kutzmann, who believe that leukoplakia is a protective cornification; that epithelium possesses a dual potentiality (1) that it differentiates and exercises a normal function according to location but (2) has the inherent ability to call forth a protective mechanism in a uniform way in the presence of irritants.

Haythorn[14] after a study of leukoplakia of the bronchi concluded that the mucosa being destroyed beyond the hope of specific regeneration, sought to protect itself with the best reparative cells it could produce; hence, this hyperplastic, squamous cell membrane. He further pointed out that if the basement membrane was destroyed by irritants, the way was opened for hyperplasia beyond the basement membrane, which would favor the development of new growths, especially squamous cell carcinoma.

Fig. 2. Showing epidermoid transformation and keratinization.

Richey suggests that this change in the histology of the mucous membrane results from its trying to adapt itself to a new environment.

Ribbert[15] also believed that the type of abnormal pathology in surrounding tissues was a factor in determining the type of cell regenerated.

Leber[16] believed the process a protective one against a specific bacterial irritant because he found the same bacteria on the leukoplakia of the renal pelvis as on the xerosis of the conjunctiva. However, no one has been able to prove that a specific bacterium or bacterial toxin can produce such a cornified mucous membrane.

The practical way of looking at the lesion is that it is a protective mechanism against an irritant, but if this is so, it certainly occurs too infrequently for the ordinary irritants such as infection and stone to be assigned specific roles.

It is, therefore, evident that some other factor is responsible for the lesion. The assumption by some men that ectodermal tissues in some way gained a foothold in the lining membrane of the kidney pelvis has been advanced. Thus, it was thought that the epithelial extension to the urinary tract could take place through fistulas, a remote possibility which has been discarded.

Lecene[17] advanced the idea of epithelial cell rests, which might occur owing to the complex development of the Wolffian body and its close relationship with early ectodermal tissues. This congenital misplacement of ectodermal tissues is supported by Staehlin[18] and others who believe that the anterior portion (Pronephros) of the Wolffian body is of ectodermal origin. The excretory duct of the Pronephros has been shown to be included in the ectoderm. Because of these early complicated embryonical contacts of the developmental tissues of the urinary tract with ectodermal structures, it was believed that many opportunities were afforded for inclusion of nests of ectodermal cells along the urinary tract. Ribbert believed that this was the logical explanation of the entity, and added that these cells may appear normal in their location but possess embryonic potentialities, and that they may be only partly differentiated, and, therefore, undergo changes more readily.

Investigations that support the congenital phase of its origin are those of Lavonius[19] who found 5 cases in 150 kidney pelves examined in which the conformation of the epithelium was such that it might give rise to leukoplakia. Heymann[20] noted small areas of cornification in the bladder mucosa in 10 or 20 cases examined. Albarran thought these areas congenital in origin and capable of giving rise to leukoplakial changes.

While such data is relatively meager to support the theory of cell rests, nevertheless, the idea cannot be discarded until further evidence disproves it, or until other theories, such as metaplasia, gain further support.

The most interesting phase concerning the origin of leukoplakia centers about the phenomenon of metaplasia. The normally developed adult epithelium of the urinary tract maintains specific functional and structural characteristics under normal conditions. Abnormal conditions may stimulate these cells to assume the characteristics of another type. The type, cause, and manner of this call change has given rise to much speculation. Virchow[21] first used the term, "Direct Metaplasia," to denote the direct change of one cell into another cell architecturally different but still maintaining some structural characteristics.

Schridde[22] states that the formative cells of the growing epithelium may give up their specific attributes and revert to a cell which has all the powers of differentiation possessed by the embryonic cell from which the epithelium was developed or, "Indirect Metaplasia."

Orth[23] has given us a definition of metaplasia that is more accurate and fits the pathological findings more satisfactorily when he says that it is a transformation of a well characterized tissue into another, equally well characterized but morphologically and functionally different.

The development of leukoplakial tissue through metaplastic processes means that there is no analge of ectodermal tissue present preceding its development. It signifies a direct or indirect change of the transitional epithelium of the pelvis to one with epidermoidal characteristics. Those, who believe in the congenital origin, state that small nests of ectoderm are couched in the transitional epithelium and as a result of irritants become cornified, and that the process extends from these nests and replaces normal mucosa as it is destroyed.

Wolbach and Howe[24] found the urinary mucosa involved at times with a stratified keratinizing epithelium comparable

to leukoplakia where a diet that was deficient in vitamin A was fed to rats. They found the epithelial structures the earliest to be affected by vitamin A deficiency. They concluded from their observation that, "the sequences are atrophy of the epithelium concerned and the substitution for it of a stratified keratinizing epithelium identical in appearances in all locations and arising from focal proliferation of basal cells." They believe that vitamin A deficiency results in epithelial starvation and atrophy, which stimulates a reparative proliferation of basal cells which alone are capable of multiplying in epitheliums with secretory functions. The new, or reparative, cells which replace the old in all locations and regardless of previous functions and morphology acquire a common form and arrangement, that of a stratified keratinizing epithelium.

Wolbach and Howe further observed that it was the basal layer of cells, which correspond to the stratum germanitivum of the skin, that was capable of producing the keratinized layers when vitamin A was withheld as well as reproducing the normal epithelium when it was supplied. Evidently these cells preserve the identity of the original epithelium during the metaplastic period, and can reassume their original function and morphology when it is supplied.

It is interesting to note that this deficiency lesion is a distinct entity and originates without any of the irritative factors often observed by the clinician in leukoplakia of the kidney pelvis, such as infection and stone, which are often considered as etiological factors. Practically all of the histological studies of leukoplakia of the kidney pelvis reported emphasize the cellular infiltration underlying the keratinized membrane.

Wolbach and Howe particularly emphasize the fact that, "the metaplasia of A deficiency in rats, guinea pigs, and human beings does not excite an infiltration reaction, no matter how long the deficiency has continued unless secondary infection has occurred, and that vitamin A deficiency does not increase susceptibility to infection by bacteria. . . . " Practically, these experimental facts fit in nicely with clinical findings. It is doubtful whether any symptoms are initiated by an uncomplicated leukoplakia of the kidney pelvis. It is only after infection has occurred, or tumor and stone formed, with their attendant symptoms that patients have presented themselves for examination. However, before much weight can be attached to this type of keratinization of epithelium, evidence is needed to support it clinically in case of deficiency of vitamin A in man. Again it should be known whether the processes are identical and lastly can similar processes be initiated by separate and distinctly different types of irritants, one of which is constitutional and the other local.

The clinical significance of leukoplakia of the urinary tract is its not infrequent association with squamous cell carcinoma. It has always been considered a precancerous lesion regardless of location and evidences accumulating to show that it may precede carcinoma of the kidney pelvis.

Patch[25] has recently made a study of 152 cases of squamous cell carcinoma of the kidney and bladder; in 13 cases leukoplakia was associated with the malignancy. In his own cases he was able to demonstrate the transitional stages from leukoplakia to malignancy; Hinman has suggested the same relationship. It is possible that the leukoplakia may have preceded the malignancy in a larger number of cases but was not evident at the time the tumor was discovered, due to its replacement by the malignant process. Squamous cell carcinomas have also been reported associated with leukoplakia in the kidney pelvis; thus, Kutzmann found 8 malignancies in 67 cases, only 5 of which, however, were squamous cell carcinoma. Potts has recently reported another making this particular type of tumor occur in 8.4 per cent of renal leukoplakias. We

suspect that this percentage is too low, as it is possible that the leukoplakia occurs more frequently than reported in malignancies of the bladder and kidney because as a precancerous lesion it may be overlooked or entirely replaced, while the malignant tendencies of a leukoplakia may be overlooked due to insufficient examination of the specimen.

Clinically, leukoplakia is not peculiar to any age group. Leber reported it in a patient of four years and Halle one at seventy years of age, the majority occurring between thirty and fifty. It occurs about equally in either sex but there is a preponderance of unilateral lesions which add some comfort insofar as therapy is concerned. It has occurred as a bilateral lesion but three times in 57 of 72 cases reported including the author's.

The symptoms accompanying the lesion are usually those of infection, stone or tuberculosis which so completely dominate the picture that leukoplakia is unsuspected. The patient usually presents a history of a chronic urinary infection with or without stone formation of long standing. In our case such symptoms existed over a period of sixteen years. An analysis of Kutzmann's collection and 5 additional cases show the following clinical and diagnostic data to point to infection as responsible for the preponderance of symptoms and diagnosis. Thus, 45 cases had a cystitis; 41 pyonephrosis; 28 stone; 32 hydronephrosis; 10 tuberculosis and 9 carcinoma. Such lesions cannot help but emphasize their importance as etiological factors in the production of leukoplakia of the renal pelvis. However, one must not loose sight of the fact that leukoplakia is a pathological process at the same time that it is probably playing a physiological role (Hinman and Gibson) and may have preceded the associated pathology, whether infection, stone, or tumor.

The lesion is seldomly diagnosed before operation or autopsy as the only clinical indication of it is the passing of cornified epithelial plaques in the urine. Beer and Stockman[25] have reported such findings. Our patient gave a history of passing dirty, gray urine at times and we examined such a specimen but the presence of pus and blood caused us to pay no attention to the epithelium present. Hematuria was a prominent symptom in our case and was reported in 35 per cent in Kutzmann's collection. Hematuria, however, in the presence of other evident pathology would carry little diagnostic significance.

The lesion produces no painful symptoms except where obstruction from masses of epithelium, pus, or stone are blocking the ureter or where there is a stricture of the ureter. One observation that may give a clue to the lesion in the kidney is the presence of leukoplakia in the bladder. In 72 cases herein collected, 6, or 8.3 per cent, presented bladder leukoplakia. The presence of a leukoplakia should be suspected in long standing irritating lesions of the kidney pelvis.

The treatment of leukoplakia is usually directed at the associated pathology which is very often extensive and unilateral; in such cases nephrectomy is indicated. If the lesion is diagnosed, it should require nephrectomy on the basis of a precancerous lesion. Finally, if the lesion is bilateral, palliation in the form of promoting drainage to the kidney pelvis and lavage to lessen the infection are indicated.

SUMMARY

1. Another case of leukoplakia of the kidney pelvis is reported and 4 additional cases collected from the literature making a total of 72.

2. The cause of this tissue change is unknown; the theories advanced to explain it are:

(a) Congenital displacement of ectodermal cell nests;

(b) Metaplasia of the normal mucosa from local or constitutional irritants. Clinically, the influence of infection, and stone is probably the most significant factor in initiating the lesion.

3. Our case was characterized by:
   (a) Long standing infection, stone, hematuria, and pain;
   (b) Incorrect diagnosis of tuberculosis;
   (c) The finding at operation of a large amount of edematous fibro-fatty tissue surrounding the pelvis and ureter;
   (d) Microscopically, the absence of carcinomatous changes.

4. The treatment when unilateral is nephrectomy.

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NINETY-SEVEN POUND FIBROMYOMA UTERI*

REPORT OF CASE

W. S. WHEELING, M.D., AND J. A. ORRIS, M.D.

Chief Surgeon, Windber Hospital

Associate Surgeon, Windber Hospital

WINDBER, PA.

A RESUMÉ of the literature concerning fibroids of the uterus both of the solid and cystic form has shown many large tumors to have been removed successfully with complete recovery. The case which we wish to present was a ninety-seven pound fibroid tumor with some cystic degeneration at the lower part and, as far as we can learn, is two pounds heavier than any of the other fibromyomata which have been successfully removed. Cocram[1] in 1911 reported having removed a ninety-five pound solid myoma from which the patient made an uneventful recovery.

We are grateful for Owings,[2] of Baltimore, review of "Large Cystic and Solid Uterine Myomas" reporting 33 cases weighing over thirty pounds. The following data is gleaned from his résume: The mortality rate of the entire series was 21.4 per cent. In the 25 cases whose ages were known they varied from twenty-three to sixty-five years of age, in 20 of these cases it was from thirty-five to fifty-nine years. In 24 cases where the duration of symptoms were available, 9 had symptoms twenty to twenty-six years, 6 had symptoms ten to eighteen years, 7 had symptoms five to eight years; while the 2 remaining cases had symptoms eight months and one year respectively, these latter cases being fibrocystic and cystic myomata. Of the 33 cases, 21 were true myomata or fibromyomata of either a soft or solid nature, the 12 remaining cases were cystic or fibrocystic in nature. Of the 33 cases, 6 died a few hours to six days following operation, one died six days after paracentesis, 2 of the tumors are the reports of autopsies, in one of the cases the result was not given, in another case the recovery was given as questionable, 22 of these cases were reported as recoveries following operation.

"A cystic fibroid weighing forty-seven pounds and simulating an ovarian cyst," reported by Greenhill,[3] was removed at autopsy, the patient having succumbed from an acute illness. There was a history of the patient having had seventy-five paracenteses in the past year. Upon opening this tumor he states that four quarts of a very foul smelling fluid was obtained.

REPORT OF CASE

Mrs. M. K. aged forty-eight years, white, married, complained of a large abdominal mass; pain in the abdomen and back while standing or walking; nervousness; loss of weight; weakness; insomnia; and cramps in the feet and legs.

Family History: Her mother died at the age of sixty-six years following an accident. Her father died at the age of seventy-two years of pneumonia. Six sisters were living and well, one had a goiter removed successfully. Four brothers were living and well. Four sisters died, one of meningitis; one accidental; and 2 of diphtheria.

Personal History: She had measles, mumps, chickenpox, whooping cough, diphtheria, several attacks of bronchitis, pneumonia on two occasions and influenza in 1919. The patient has had nocturia two to three times a night for the last two years and also has to urinate immediately upon turning on her right side in bed.

Operations: She had an appendectomy in 1920.

Menses were established at eleven years of age, always regular until six years ago follow-

* From the Department of Surgery, Windber Hospital.

ing the death of her child, when she began to menstruate rather profusely and continued to do so for six months, and have been somewhat more profuse to the present time. She has had a continual clear and watery discharge since that time which has on occasions been slightly blood tinged.

FIG. 1. FIG. 2.

FIG. 1. Side view of patient on August 2, 1934; weight 177½ lbs.

FIG. 2. Front view.

Marital: The patient has been married eighteen years. She had one child which died at the age of eight years, six years ago. She has had no miscarriages or abortions. Her husband is living and in good health.

Present Illness: Following the birth of her only child in 1920 patient began to have bearing down pains and quivering sensations in her lower abdomen. In 1925 she noticed a mass in her left lower quadrant which she states was about the size of a pineapple. Since this time the abdominal pain has increased in severity and the mass has continued to enlarge. The patient states that her weight in 1924 was one hundred eighty-four and one-half pounds. Together with the loss of weight she has also suffered from insomnia, weakness, nervousness and cramp like sensations in her legs and feet. Up until the present time she has been able to do the greater part of her housework with some assistance from the members of her family.

Physical Examination: The patient was lying in bed on her left side. The patient is of a rather tall stature, five feet, eight and three-fourth inches in height; emaciated in appearance; skin is dry with poor elasticity; the eyes are markedly sunken; pupils are equal; react to light and accommodation and when standing her posture was quite stooped due to the weight of the tumor. There are some carious teeth present. The neck is thin, long and scrawny. There is marked emaciation of the entire chest wall, the scapula, clavicles and sternocleidomastoid muscles are quite prominent. The breasts are atrophied. Excursion of the chest is equal bilaterally on inspiration, as is vocal fremitus. The chest is resonant; the breath sounds are clear and no rales are heard. The apex beat of the heart is in the fifth interspace slightly outside the midclavicular line. The heart sounds are slightly more distant than normal; there are no shocks, thrills or murmurs present. The blood pressure is 118/78.

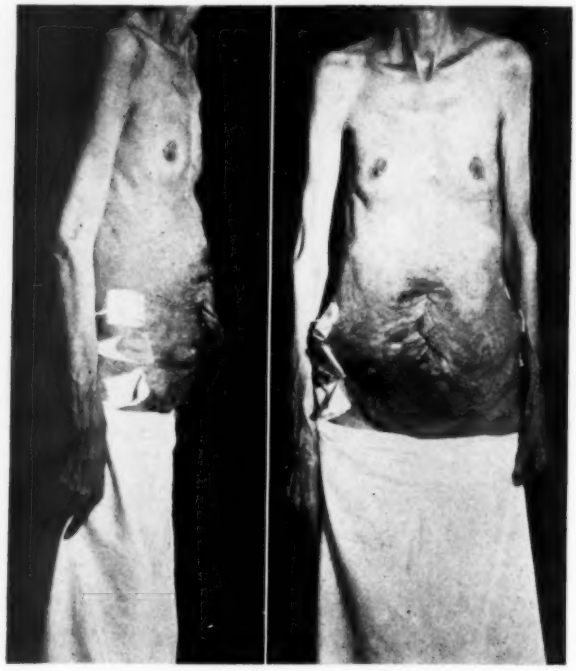

FIG. 3. FIG. 4.

FIG. 3. Side view of patient on Sept. 16, 1934, one month after operation. Weight 97½ lbs.

FIG. 4. Front view.

Abdomen: There is a large pendulous abdominal tumor producing a protrusion of the abdomen from the lower costal margin and extending approximately to the upper level of the patella. There is a large tortuous vein beginning at the xiphoid process and extending over the anterior surface of the

abdominal wall slightly to the right of the umbilicus and terminating at its lower portion. The skin is somewhat pigmented and rather

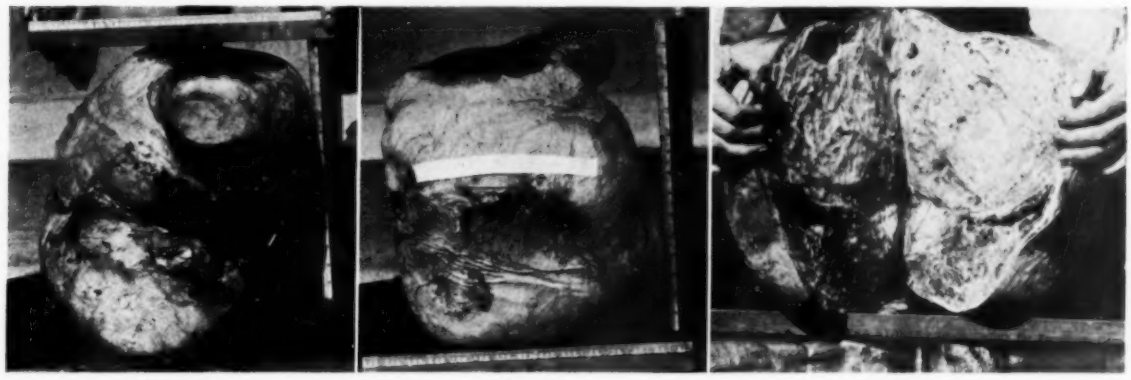

Fig. 5. Fig. 6. Fig. 7.

Fig. 5. Gross appearance of large fibroid which had been removed one month previously. Weight of tumor is 65 lbs. The white stick seen on the right side of the tumor enters the uterine cavity and represents the point of excision with the upper portion of the uterus.

Fig. 6. The portion seen slightly below the white strip of paper represents the attachment of the left Fallopian tube and ligaments.

Fig. 7. Sectioned in midportion in the same plane as the rulers seen in Fig. 6. The greater part of the tumor is of the compact fibroid material; at the lower portion there is considerable cystic degeneration.

thick. On palpation the mass is firm with the exception of an area about 4 inches from the xiphoid to the upper margin of the tumor which is soft and which on percussion is tympanitic. The tumor mass is firm on palpation over its greater portion with some suggestion of an increased softening at its lower portion. The entire mass is flat on percussion.

Extremities: The arms and legs are quite long and emaciated. There is no evidence of any swelling, edema or clubbing. There are no tremors present. Reflexes are normal.

Temperature was persistently between 98.2° and 101° previous to operation but gradually fell to normal following operation.

The urine was one plus for albumin on admission with many pus cells and on one occasion, two days after operation, there were granular casts, blood and an increased amount of albumin present. At the time of her discharge, however, the urine was practically negative with the exception of faint traces of albumin.

Blood count: August 2, 1934, showed red cells 3,130,000, with hemoglobin 39 per cent and color index of .62; white cells 13,400 with a differential of polymorphonuclear 82 per cent, segmented 76; small lymphocytes 14 per cent stab. 6; large mononuclears 1 and eosinophiles 3. The red blood cells showed considerable anisocytosis, few microcytes, occasional poikilocytes and marked achromia.

August 2, 1934, the weight of the patient was 177½ pounds.

August 4, 1934, 425 c.c. of blood was given by the Unger method.

August 7, 1934, *incision and drainage* was done under local anesthesia on the anterior abdominal wall slightly to the right and about 4 inches below the umbilicus. An incision made through the skin, fascia, and small amount of muscle tissue revealed a pearly, transluscent and fairly thick membrane. When this membrane was incised, the finger was inserted and a fairly large amount of cloudy amber fluid exuded; a rubber tube was inserted and sutured to the skin for drainage.

August 9, 1934: 450 c.c. of blood was transfused by Unger method.

August 16, 1934: *Operation:* Under local anesthesia an elliptical incision was made about two feet in length, incorporating the umbilicus and the previous incision which had been made for drainage. The skin and fascia together with the parietal peritoneum of the incision were removed after separating the peritoneum which was adherent to the cyst wall. The bladder was rather high and somewhat adherent to the lower pole of the tumor and the left broad ligament. The left Fallopian tube and round ligament with the broad ligament were adherent to the lateral and posterior wall of the tumor mass. The left ovary could not be

identified. The left adnexa was enlarged to about the size of a child's arm and contained a rather large plexus of veins. These were clamped and ligated from their attachment together with the broad ligament which seemed to encase a portion of the tumor. There was also considerable cystic degeneration of the left broad ligament and tube. The tumor was then approached from its upper portion, adhesions being separated between the omentum and the tumor wall; at its lower portion the tumor was continuous with the uterus. It was necessary in the removal of the tumor therefore to excise the greater portion of the fundus of the uterus. The denuded surface of the uterus was approximated and other denuded areas were peritonealized, the vessels being secured with suture ligatures. Before attempting closure of the abdomen, a moderate amount of cystic degeneration of the peritoneum present, was excised. The abdomen was closed with continuous doubled No. 1 catgut incorporating the peritoneum, fascia and muscles with the same suture due to the thinness of the abdominal wall. The skin was closed with continuous equisitine suture.

August 21, 1934: 500 c.c. of salt solution and 500 c.c. of 10 per cent glucose were given intravenously.

PATHOLOGICAL REPORT

Gross Description: Specimen consisted of a large, irregularly shaped solid tumor mass. It weighed 65 pounds and measured 40 × 32.5 × 20 cm. No normal uterine or ovarian tissue could be found.

The external surface of the mass was smooth and shiny and was extremely vascular. Upon section, the tumor was found to present a varying structure. There was a dense outer layer measuring about 0.5 cm. in diameter completely surrounding the mass. The inner part of the tumor had the appearance of a fibroid which had undergone degeneration. In some areas it was extremely firm and was whitish; in other parts the tissue was soft and pink; in still other regions degeneration had occurred and the cystic places contained a pseudomucinous material. There were a few areas of calcareous degeneration.

Microscopic Description: The tissue was composed essentially of interlacing bundles of smooth muscle and fibrous tissue characteristic of uterine fibroid. The tumor was quite cellular but did not have the appearance of being malignant. There was considerable vascularity. At one area there was cystic formation and colloid degeneration in another.

Final Diagnosis: Fibromyoma uteri with cystic degeneration.

From the following data the weight of the tumor was deduced:

Weight of patient on admission, August 2, 1934	177½ lbs.
Weight of patient on September 5, 1934, 20 days postoperative	89 lbs.
Weight of tumor removed August 16, 1934	65 lbs.
Fluid obtained by drainage through incision August 7, 1934	14 lbs.
Fluid obtained by drainage from August 7 to August 16	18 lbs.
Total weight of tumor therefore was	97 lbs.
Gain in weight of patient in twenty days following operation	8½ lbs.

The patient continued to improve and gain weight; the following are weights recorded at later dates:

Weight on September 16, 1934	97½ lbs.
Weight on September 26, 1934	106½ lbs.
Weight on November 10, 1934	129 lbs.
Weight on November 28, 1934	134½ lbs.
Weight on December 14, 1934	141½ lbs.
Weight on May 24, 1935	148½ lbs.

These figures not only show the weight of the tumor but they also show the rapid convalescence which was made following operation.

Comment: We consider this case of interest because of its unusual size and the uncomplicated recovery which this patient has made. The physical condition of this patient perhaps was better than those which have been reviewed and because of this the outcome has been favorable.

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HYPERTENSION, OBESITY, VIRILISM AND HIRSUTISM ASSOCIATED WITH ADRENAL CORTICAL CARCINOMA

RICHARD JOSEPH WHITE, M.D.

FORT WORTH, TEXAS

THE gradual realization of the profound influence on metabolism, sex characteristics and in some instances blood pressure which certain tumors of the adrenal cortex exert has been one of the most interesting chapters in the study of the glands of internal secretion. That these changes have always interested medical men is borne out by Arthur Collett's statement that Hippocrates described 2 cases of virilism in married women whose bodies resembled the male and were covered with hair, they each had a beard and their voices were deep. He says that William Cook in 1756 was the first to give a more exact description of a case in connection with a suprarenal tumor in a seven year old girl. She was enormously fat with a thick growth of hair on the face and genital organs. Bevern and Romkild in 1802 described a three and a half year old girl who looked like a woman of twenty with a thick growth of hair on the genitals and face. In describing a similar case Bullock and Sequeira were the first to point out that the adrenal cortex is the site of a new growth. There are recorded instances of extreme pseudohermaphroditism in infancy due to these tumors developing in fetal life. In young children they occur much more frequently in girls. The victims grow fat with the fat confined to the trunk, neck and face, the clitoris may become huge, hair grows on the face and body, the voice becomes coarse and deep and thickening of the vocal cords has been observed laryngoscopically. If they live until the normal time for the catamenia they usually do not menstruate. Cecil cites exceptions to this, however. Hypertension has been recorded even in very young children. In young boys the virile tendency is striking. A beard, a deep voice, mustache, profuse pubic hair, a man sized penis and sometimes the most astonishing muscular strength are seen. Geschichter cites a case of Park's with bilateral adrenal cortical hyperplasia whose strength was such that at two years he could over power children seven and eight years of age. At four his penis measured four inches, he had a mustache, his weight was seven kilograms above the predicted value and the epiphyseal development of his bones that usually seen at puberty. A few of these children with a slowly growing tumor have become prematurely senile and died young. True pubertas praecox in the sense of potentia or spermatogenesis is evidently very rare.

In adults these tumors have occurred preponderantly in women and their most conspicious effect has been in as far as it is possible in the mature state to make a man out of a woman. Growth of facial and body hair has been marked. The male escutcheon has appeared on the abdomen, the voice has deepened and roughened, menstruation has become scanty or ceased, a masculine case of features has appeared, an aversion to intercourse or in a few instances a reversal of sex interest has appeared and in some cases a loss of normal feminine modesty. A considerable number of adult women have had a very pronounced hypertrophy of the clitoris. In many cases the appetite has increased enormously and there has been a large gain in weight with distribution of fat to the trunk, face and neck, sparing the extremities. There has often been hypertension which is somewhat variable, and dyspnoea and edema have been frequent complaints and hypertrophy of the heart has been demonstrated. The hypertension is not of

the classical paroxysmal type which, in the cases of Rowntree and C. H. Mayo, Shipley and Pincoffs and the Porters, has

FIG. 1. Distribution of eruption on upper part of body. Hair growth not well shown as patient refused photograph to be taken until after operation.

been proved by operative removal giving relief, to be due to a paraganglioma arising from the adrenal medulla, but must be related in some way to the metabolism of adrenalin. These tumors are rare in men but are said to produce a pronounced virilism; however, several cases of the opposite experience are quoted, notably that of Bitdorf-Mathias in which a man twenty-six years of age had shortness of breath for eight months, enlargement of breasts for one year and a few months later the testes began to atrophy. Six months later he became impotent and in eight months a tumor of the left part of the abdomen was observed. Soon widespread metastasis was apparent. Autposy showed hypernephroma of suprarenal cortex. Both breasts showed glandular tissue. The interstitial cells in the testes were hardly developed. Geschichter quoting Holl cites another remarkable instance of a man forty-four years old who had enlargement of the breasts and pigmentation of the

FIG. 2. Acneiform eruption, coarse features and hair growth on the face. Patient had tweezed many hairs out of face.

nipples. The testicles and penis decreased in size and sexual feelings were lost. He gained in weight and the masculine expression of the face was lost. A tumor over the left kidney was removed followed by a return of male characteristics.

Three explanations of the sexual changes observed in adrenal cortical tumors have been offered. (1) The adrenal cells of the tumor act indirectly on the gonads. (2) The adrenal cells retain their primitive sex functions and produce these changes. (3) The adrenal cells stimulate the cells of the anterior pituitary which in turn act on the gonads. This is a most intriguing theory in view of the marked similarity clinically between the effects of the basophilic adenomata of the pituitary and cortical tumors, but in Frank's case with a typical Cushing syndrome characterized by obesity of the face and trunk, hirsutism, so called pig eyes, persistently high blood pressure with attacks of hypertension, amenorrhea and menstrual irregularity, pinkish skin stria, rarefaction in bones,

polycythemia, cyanosis of extremities and susceptibility to infection; in short every diagnostic point necessary to establish Cushing's disease, at autopsy a large adrenal cortical carcinoma was found but no trace of a pituitary adenoma. Robert Frank studied another very similar case finally proved at autopsy to be an adrenal cortical carcinoma and found that in both instances the clinical picture was that of a basophilic adenoma of the pituitary. Hormone tests for four weeks showed negative pregnancy tests and no increase in prepituitary and female sex hormone circulating in the blood. On the other hand, the excretion of female sex hormone in the urine was at times tremendously increased to a degree seen normally only in pregnancy (13,000 mouse units per litre). He since has tested several cases thought to be true examples of basophilic adenoma of the pituitary and the female sex hormone was not increased. He thinks this might serve to differentiate the two conditions in an early and operable state.

An acneiform eruption has been a conspicuous feature of many of the cases described. The skin often is coarse and oily and the eruption is usually confined largely to the face and chest. There are several cases described of diabetes associated with hirsutism and a cortical tumor, the "Diabete des femmes barbes" of the French. The case of Achard-Theirs was a woman seventy-one with masculine facies, large mustache and beard, heavy eyebrows and the blood pressure was 220/100. She lost several grams of sugar daily in her urine but diet controlled this. At autopsy both suprarenals were enlarged and showed marked hyperplasia. Keyser and Walters describe a case with an adrenal cortical carcinoma associated with a thyroid disturbance and diabetes. Doubtless the pituitary plays some role in the cases associated with diabetes.

TREATMENT

In most instances the tumors which produce these changes are malignant and extensive and for practical purposes inoperable but as Lesser says almost any reasonable risk is justified if there is a chance of relieving these poor people. The remarkable and often quoted case of Gordon Holmes is an illustration of what may be occasionally accomplished. A girl, formerly very attractive physically, developed a heavy beard and general hypertrichosis due to the slow growth of a tumor starting in the cortex of the right suprarenal. Her features changed to resemble the male. Menstruation ceased, her clitoris hypertrophied and she lost all interest in the opposite sex and preferred the society of women. The right suprarenal was removed and all signs of virilism disappeared. Regular menstruation reappeared, the clitoris returned to normal size, abnormal hair fell out, her breasts developed and in general femininity reappeared. Nine years later she was still a perfectly normal woman. In patients with the large cortical tumors that have been operated they not infrequently have survived the immediate effects of the operation but have died in twenty-four to seventy-two hours with low blood pressure, fast pulse and loss of consciousness and at autopsy the other suprarenal has been found atrophic. Walters thinks he has tided a patient or two over by injections of eschatin postoperatively. This atrophic state of the opposite adrenal fortunately has not been found in the medullary tumors causing paroxysmal hypertension.

PATHOLOGIC ANATOMY

The adrenal is a compound gland. Its central or medullary portion belongs to the chromafil system so-called from its characteristic staining together with the paraganglia of the sympathetic nervous system, the carotid and aortic bodies, to any tint between yellow and dark brown in the presence of chromium salts. The function of these cells is to secrete adrenalin and they are not necessary to life. The cortex of the gland originates from the Wolffian body and its secretion is necessary to life. Ewing states that the tendency of many of

these tumors to reveal mesoblastic or sarcomatous origin has recalled occasionally their mesothelial origin but the acquired epithelial character of the cells predominates in most of the growths, which behave as adenomata or carcinomata. Diffuse hyperplasia, adenomata or carcinomata all occur. The carcinomata are soft, yellowish and prone to necrosis and hemorrhage. Central softening may yield cysts of large size. Early and widespread metastases are a prominent characteristic of adrenal cortical carcinoma.

CASE REPORT

Mrs. J. T. H., age thirty-seven, had been normal all her life until the onset of her present illness, menstruated regularly and had a healthy child, thirteen years old. Her first complaint occurred eight months before I saw her and consisted of a sharp attack of pain in her left upper abdomen which lasted three days and required morphin for relief. She had been of a quiet temperament but was extremely nervous and had headaches and weakness for some time following this. Her upper abdomen was quite tender. Her physician told her she was threatened with a "nervous breakdown." After three months she noticed short episodes of breathlessness and that her period was delayed and scanty and that hair in large quantities was beginning to grow on her body, face and extremities. Shortly after this a lump was discovered in her left upper abdomen and thought to be the spleen. A pyelogram demonstrated a normal pelvis in the left kidney with the kidney displaced downward and its upper pole rotated somewhat inward. Her doctor stated that she was carrying a marked hypertension at this time, his letter three weeks before I saw her stating his last record was 164/110. She had been in Fort Worth more than two weeks when I saw her with Dr. C. P. Higgins. Her lump had grown rapidly. Cystoscopic examination had been repeated and the kidney displacement was more marked. For several weeks she had had a most annoying skin eruption diagnosed by a dermatologist as a drug rash attributed to amytal of which she had been taking large quantities. She had gained fifteen pounds in weight and said she had a ravenous appetite. She had had several chills followed by high temperature for a few hours, and the negative cystoscopic urinary findings together with the lump previously diagnosed as spleen, had led to an energetic but vain search for malaria. Her voice was coarse, deep and husky and she said this change had been progressive almost from the onset of her symptoms. She had only two very scant menstrual periods in the last eight months. She stated that the caresses of her husband were repulsive to her but that she was not especially averse to intercourse. On examination her bloated, obese appearance, the papulo-pustular eruption involving her entire body from the hips upward, most marked on her face and anterior chest, the profuse growth of hair over her body with male distribution on the abdomen and the coarse voice made a very striking picture. There was a large, firm, slightly tender tumor, the size of a fetal head at term protruding beneath the left rib margins and extending past the midline and down to the level of the umbilicus. Pelvic examination showed a small, freely movable uterus. The tubes and ovaries could not be felt. The clitoris was distinctly though not hugely hypertrophic. The blood pressure was variable but did not reach over 155/100 at any time it was recorded.

Her blood count showed 4,080,000 red cells and hemoglobin 70 per cent. The leucocytes were normal. Her blood Wasserman was negative. The blood sugar was 100 mg. per 100 c.c. Her urine showed a trace of albumin and a few granular casts.

It was apparent that the tumor was not spleen but originated almost certainly from the adrenal cortex. Upon abdominal exploration there was found a huge semifluctuant retroperitoneal tumor across which the body and tail of the pancreas were stretched. It was clearly inoperable. A trocar and cannula were inserted and some bloody fluid and a mass of yellowish tumor cells large enough for a microscopic examination were secured. The bleeding was controlled with two stitches. The spleen was atrophic and the kidney displaced downward and mesially. The abdomen was closed in layers.

Pathological Report: The biopsy removed from this tumor at the time of exploratory operation consisted of a very small, hemorrhagic, friable, pinkish brown piece of tissue. Microscopically the sections showed a small amount of fine vascular stroma, large areas of necrosis with hemorrhage and sheets of tumor

cells. The tumor cells varied greatly in size and shape, the majority of the nuclei being hyperchromatic and contained many mitotic figures in the different phases of development. There was no evidence of attempts to reproduce the zona glomerulosa or the columns of the zona fasciculata. The cellular arrangement was much wilder and no adrenal structures could be recognized. In some areas the tumor cells showed a decided perivascular arrangement, frequently found in the more active, anaplastic, malignant, adrenal carcinomata. The pseudopapillary type of cell arrangement that has been described as occurring in some cases of highly malignant adrenal tumors, due to the softening of the central lines of tumor cells, was not observed in sections from this tumor.

The numerous chills which she had were no doubt due to the necrosis in the central portion of this massive tumor growth.

Her subsequent course was rapidly downward. When she left for her home in West Texas six weeks postoperatively she was complaining of increasing paroxysmal breathlessness. Three months later her home physician wrote that she had extreme edema of the legs, slight jaundice, severe dyspnoea and a marked increase of hair growth on her face. Shortly after this she died. A more dramatic example of the perversion of endocrine function could hardly be imagined.

SUMMARY

A case is presented showing all the outstanding features commonly associated with an adrenal cortical tumor, namely hypertension, obesity, virilism, hirsutism, coarse voice and acneiform eruption. The diagnosis is confirmed by histological examination of a piece of tissue excised from the tumor. A brief review of the literature of this rare condition is submitted.

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ABNORMALITIES OF ROTATION OF MIDGUT

H. H. DONALDSON, M.D., F.A.C.S

Mercy Hospital

PITTSBURGH

THE management of the occasional case showing unfamiliar pathology presents one of the greatest difficulties to the surgeon often due to inexperience in treating such lesions and especially to lack of knowledge of the cause of the disease. An experience with a case of rotation of the midgut made us conscious of our shortcoming concerning the cause and results of such abnormalities. We will not go into the details of the embryology of the intestinal tract but will try to emphasize how important is the matter of the rotation of the midgut. Our comments are based on published papers and on a limited experience.

Some important preliminary statements are in order. The foregut ends at a point in the duodenum just proximal to the bile and pancreatic ducts. The function of this portion is largely digestive and its blood supply is from the celiac axis. The midgut begins at the lower limit of the foregut and extends to a point just beyond the middle of the transverse colon. The absorptive function is largely in this portion and its blood supply is from the superior mesenteric artery. The remainder of the tract is composed of the hindgut and its function is largely excretory, its blood supply being from the inferior mesenteric artery.

The fact of rotation had long been recognized but it was not until 1915 that an attempt was made by Fraser and Robbins to explain its cause. The foregut and the hindgut are not concerned in the problems of rotation.

At about the fifth week, elongation of the midgut and the rapid increase in the size of the liver causes insufficient space in the abdomen and results in the midgut protruding into the umbilical cord producing a physiological umbilical hernia, or the first stage of rotation of the midgut. Rarely, a portion of the intestinal tract remains in the umbilical cord and its persistance until the time of birth presents the condition known as congenital umbilical hernia. Such congenital hernia may contain all or a portion of the midgut. In one case operated by Buchanan in 1908 even the liver was present. Only those cases of congenital umbilical hernia containing a portion of the midgut can be operated successfully; otherwise, there is not enough room in the abdomen to contain it. Figure 1 represents the alimentary tract at the eighth week of intrauterine life and shows the divisions into foregut, midgut and hindgut, and the completed first stage of rotation.

Since Fraser and Robbins' article apparently all writers on this subject agree as to the cause of the first stage of rotation. Excellent articles on abnormalities of rotation have been written by Dott, Gardner and Hart, and Haymond and Dragstedt and others.

The second stage of rotation includes returning the intestine from the umbilical cord to the abdomen and this occurs about the tenth week. Figure 2 represents the position at the end of the second stage of rotation.

It is difficult to explain the cause of the return to the abdomen. No traction of any kind has been discovered. Fraser and Robbins believe the return is due to suction because of the fact that the liver in this stage grows slower than the abdominal cavity, causing a fall in the intraabdominal pressure. At the same time, due to the total growth of the fetus, external pressure is exerted on the umbilical cord which also favors the return of its contents to the abdomen.

During this stage of growth a prearterial segment and a postarterial segment are described, as shown in Figure 2, the former

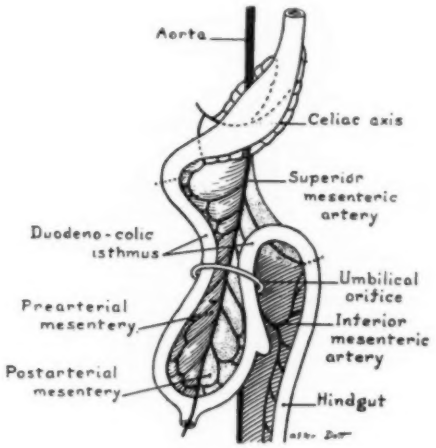

Fig. 1.

being the right half and the latter the left half. While the midgut remains in the abdomen, the prearterial segment grows more rapidly than the postarterial segment, so that the former becomes disproportionately elongated. In 2 cases reported, one by Haymond and Dragstedt and another by Lickley and Cameron, this disproportionate growth was deemed excessive and to have caused rotation into the prearterial mesentery of the postarterial segment. In their cases this persisted until adult life and in Lickley and Cameron's case death was not associated with this condition. Such a condition resembles an internal hernia, all of the small intestine being in a sac and is not exposed to view when the abdomen is opened. The above condition was found at operation by Griffith and his case corresponded almost in detail with the representation in Figure 5.

When the second stage of rotation takes place normally, the small intestine returns first, apparently because the cecum is more bulky, the result being the relative position of the colon and the small intestine found in the normal individual, the colon lying anterior to the duodenum and superior mesenteric artery. The superior mesenteric artery is the axis of rotation in this stage. If for any reason the primary return of the small intestine is impeded, as in Hunter's case in which a mesenteric cyst was attached to the jejunum, then the

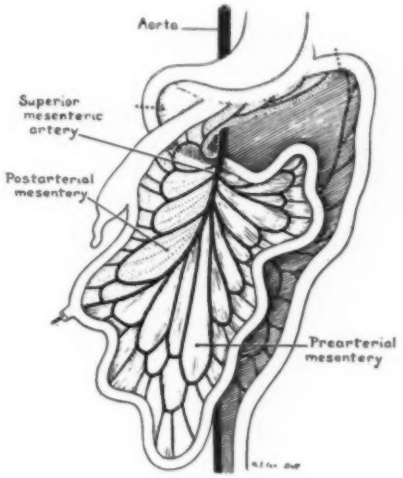

Fig. 2.

cecum may return first and the completion of rotation will be in the reversed direction and the colon will pass posterior to the duodenum and superior mesenteric artery. Such condition is known as reversed rota-

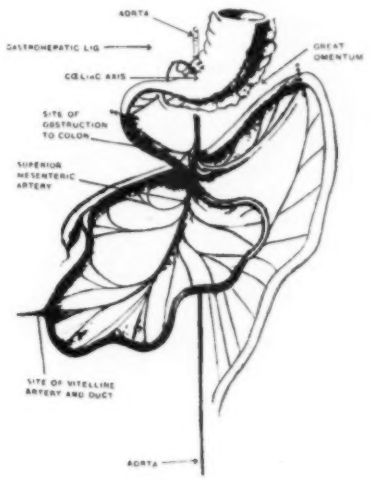

Fig. 3.

tion; therefore, the sequence of the return of the loops of the midgut determines whether rotation will be normal or reversed. Figure 3 represents reversed rotation which results in the transverse colon being located behind the duodenum and the superior mesenteric artery.

The third stage of rotation is less important and is not completed until about the time of birth. It results in the individual

loops finding their final location. The cecum rotates first into the right upper abdomen and later descends to its permanent site. Imperfections in this stage may result in the cecum being near the midline immediately under the liver or partially descended. Deficiencies of fixation in this stage may result in portions of the tract being insufficiently fastened. Variations in the permanent location of portions of the midgut often lead to difficulties of diagnosis, but the mere abnormal position does not produce, as a rule, any complications. However, as a result of the abnormal positions or fixations, adhesions may form causing obstruction or a volvulus may occur as the result of insufficient fixation.

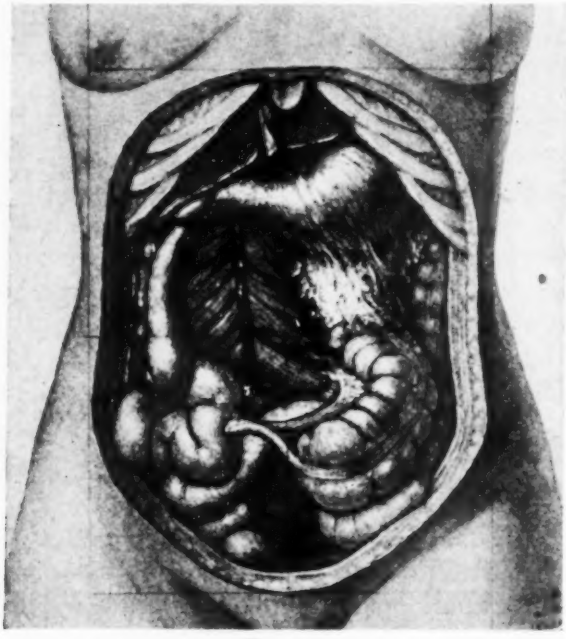

FIG. 4.

Of all the reported cases of abnormalities of rotation, the lesion most often encountered is a volvulus of the midgut loop. Its etiology requires little explanation. There is a narrow neck of attachment as shown by Figure 2. Last year Gardner and Hart cited 86 cases of such lesion from the literature. They added 2 cases which recovered after detortion of the midgut. The age in this series varied from newborn infants to the age of fifty-five years, less than one-half occurring in the first decade of life; 29 were newborn infants. In this series of cases the mortality of the unoperated group was 100 per cent.

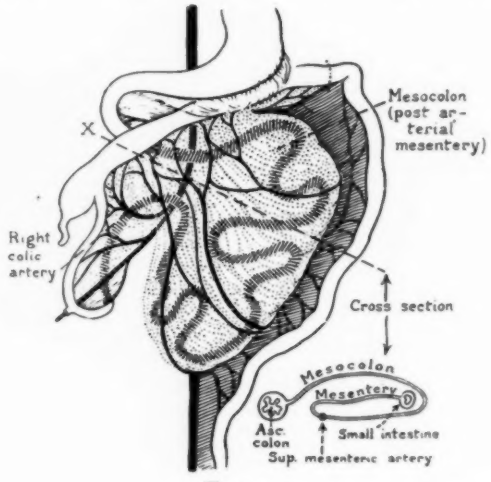

FIG. 5.

Fifty per cent of the operated cases recovered.

Another abnormality of rotation is that of non-rotation. This of itself may produce no symptoms, its importance consists chiefly in that the permanent position of the different loops of the intestines is abnormal. The entire colon occupies the left side of the abdomen, the ascending and descending colons being practically parallel and in contact, the small intestines lying in the right side of the abdomen and the ilium entering the cecum from the right. Such condition in the absence of acute pathology may be diagnosed by *x*-ray films. The appendix may be found near the midline or in the left side of the abdomen as a result of non-rotation or of an imperfect third stage of rotation. Non-rotation is shown in Figure 4.

Reversed rotation is rare. When Dott wrote very conclusively on this subject in 1927, he reported only 2 cases. Gardner and Hart last year reported 14 cases and we have found record of 4 other cases and report herewith a fifth case. The lesion found has usually been an obstruction of the colon where it passes through the mesentery of the small intestine. At operation this condition is recognized by the relationship of the duodenum and the

transverse colon, the entire duodenum being visible because it lies in front of the transverse colon. The hepatic flexure is said to be absent in most cases as it was in ours, the colon passing from the cecum directly upwards and to the left. In our case the small intestine was examined carefully from end to end and seemed to be very short. The superior mesenteric artery can be identified in its abnormal position in front of the colon.

Fig. 6.

Fig. 7.

CASE REPORT

Our patient was a girl, eight years of age, whose past medical history was unimportant, giving no hint of any abdominal abnormality. Her illness began three days before our examination with moderately severe epigastric pain and vomiting. During the first two days the bowels were moved by enemas. There was no abdominal distension at any time. The child did not appear to be extremely ill. Her pulse was 110 and her temperature was 99.4°F. She had vomited about four hours before the examination.

Examination showed a flat abdomen with moderate prominence in the left upper abdomen which was thought to indicate a distended stomach and a collapsed intestinal tract. There was some tenderness under the upper portion of the right rectus muscle, but no palpable mass. Peristalsis was active but not excessive. An obstruction of the pylorus or duodenum was diagnosed and the abdomen was opened immediately through a high right rectus incision. The entire intestinal tract was collapsed. The stomach was greatly distended and seemed to extend under the left leaf of the diaphragm for an abnormal distance. Detailed examination of the small intestine beginning at the cecum proved that the duodenum lay in front of the transverse colon. The cecum lay in the right lower abdomen and the colon extended diagonally upwards and to the left and disappeared under the distended stomach. There was a suggestion of the normal horseshoe shape of the duodenum, but the proximal portion extended deep in the epigastrum apparently to the point of obstruction. The stomach was explored and, when drawn into the wound, showed a normal spleen attached closely to the body of the stomach.

On account of so many abnormalities particularly of the position of the colon and inability to visualize the obstruction, an anterior anastomosis was done selecting the movable upper portion of the intestine.

The patient made an uneventful recovery and has been in good health since attending school regularly. She has, however, had several attacks of nausea and vomiting but these have never been associated with pain. The operation was done one and a half years ago. A recent *x*-ray study of the gastrointestinal tract showed interesting results, illustrated in Figures 6 and 7, revealing the absence of both splenic

and hepatic flexures of the colon, an eventration of the left leaf of the diaphragm showing that the colon and stomach extend to a point about three inches higher than the dome of the liver on the right side, and a displacement of the heart to the right for a distance of about three inches. Dullness and absent breath sounds at the base of the left chest on physical examination verifies the *x*-ray finding.

This is the most interesting case that we have had demonstrating abnormality of rotation and the only one showing serious disturbance of function and threatening the life of the patient. In the course of routine abdominal surgery other abnormalities of rotation have been encountered.

The following points seem important:

1. Abnormalities of rotation may result in misplacement of viscera and confusion in diagnosis.
2. Such lesions are encountered in young patients but are by no means confined to this age group.
3. As a result of misplacement with too great mobility or too much fixation, serious obstruction may occur.

SUMMARY

The object of this communication is to call attention to the practical importance of a knowledge of abnormalities of the midgut. The causes and the results are discussed. A case of reversed rotation is reported.

HEMORRHAGIC INFARCTION OF CECUM

PROBABLY CAUSED BY ACUTE GONORRHEAL INFECTION

I. B. HARRIS, M.D., F.A.C.S., FRANK E. HAMILTON, M.D. AND GEORGE E. PETERS, M.D.

Professor of Clinical Surgery, Ohio State University, College of Medicine; Chief of Staff, St. Francis Hospital; Visiting Surgeon, Grant and Starling-Loving Hospitals

Department of Clinical Surgery, Ohio State University, College of Medicine

COLUMBUS, OHIO

A REVIEW of the literature reveals that primary infarction of the large intestine is very rare. Reports on infarction of the vessels of the large intestine alone are confined, to date, to two cases. Mesenteric thrombosis is relatively common, as seen with embolic plugging of branches of the superior mesenteric vessels going to the small intestine, or the main trunk of the superior mesenteric artery, with the production of infarction of the small intestine and the right side of the colon. In addition there are about 70 reported cases of mesenterial pyemia with the production in the late stages of infarction of a considerable portion of neighboring intestine; Petren estimated that this complication is found in 5 per cent of all autopsies following death from appendicitis. But primary non-suppurative infarction of the colon alone, or portions of the colon, is quite rare; a careful search of the Surgeon-General's library for the past twenty-five years disclosed the literature on embolism and thrombosis of the mesenteric vessels to be covered quite extensively by Reich in Ergebnisse die Chirurgie und Orthopädie, in 1913 in which he reported 18 cases of infarction of the small intestine, successfully treated by operation, and not a single one of infarction of the colon. A little later, however, Bruns reported a case of hemorrhagic infarction of the cecum and ascending colon, with involvement of the appendix; and in 1929 Pendl[5] reported a case of hemorrhagic infarction of the cecum only, with no involvement of the appendix; since that time, no further cases have been reported.

The case that we are now reporting is one of primary, non-suppurative infarction of the cecum with no involvement of the appendix. In its pathological physiology it seems comparable to Pendl's case and has many points of similarity with Bruns' case, yet, as will be seen in the following analytical discussions, the history of our case shows that it is unique in surgical literature.

CASE REPORT

The patient a white, American male, age thirty-three years, was admitted to the hospital 11 A.M., November 13th, 1934 complaining of pain in the right lower quadrant. He was operated at 1:25 P.M. on the same day.

Present Illness. The patient had no complaints and no abdominal pains until November 12th, 1934 when immediately postpraudially, he noticed a slight pain all over the lower abdomen; there was no associated nausea, and within a short time the pain had disappeared. The patient continued to drive on his rounds as an insurance adjustor feeling quite comfortable; however, after his evening meal the same pain appeared in the same location with a little greater severity; but as before the pain soon disappeared. On arriving home and being hungry, he ate some sandwiches and soon had sharp pains over the lower abdomen. These rapidly became worse and were of sufficient severity as to interfere with his sleep that night. During this time there was no nausea or vomiting, but there was a constant desire for defecation, yet in spite of numerous attempts there was no bowel movement. Later he thought that although he was not nauseated perhaps

he might feel better if he vomited, so several times he gagged himself by putting his finger down his throat with no results. However, by morning he had excruciating cramping pains in the lower umbilical region; he was slightly nauseated, ate no breakfast, and vomited a small amount once. His doctor saw him 11 A.M. November 13.

Past Medical History. Previous to his present illness the patient has had no trouble with his bowels, either constipation or diarrhea; he has had daily bowel movements without recourse to laxatives. He never had a tarry stool. Nor has he ever noticed blood of any type in his stool; in his childhood he had frequently passed small amounts of mucous in his stools but this has apparently been symptomless and he gives no history of colitis. Occasionally he has passed a dark colored stool, but he states this always occurred after he had blackberry wine.

Occasionally the patient would indulge in excessive smoking for several days at a time, following which he would be aware of some acidosis, eructation of gas, slight indigestion and a cough, but these symptoms were never noticed except after excessive smoking.

He developed a gonorrheal discharge in 1928, which he thought had been cured; but after an additional recent exposure, the gonorrheal discharge reappeared November 9th, 1934. This infection was under treatment at the time of operation, became more profuse just following operation, but was quickly amenable to treatment after he left the hospital and has now disappeared.

He had influenza in 1921; a tonsillectomy and adenoidectomy in childhood; no other serious illness or operations.

His family history was essentially negative.

Social History. Patient is an insurance adjustor; driving his own car an average of about 2000 miles per month. On the day he became sick, November 12, 1934 he had driven 218 miles.

Physical Examination. Reveals a well developed, well nourished young white male. The abdomen was diffusely tender, most marked on palpation in the right lower quadrant with very slight rigidity. No masses were palpable in the abdomen. The genitalia showed a yellow urethral discharge which on smear was positive for gonococci.

All his extremities were normal.

Laboratory Examination. November 13, 1934. Blood count showed erythrocytes 5,120,000, leucocytes 21,600 with granulocytes 92 per cent, lymphocytes 6 per cent and monocytes 2 per cent.

The urine was clear amber, specific gravity of 1.022, acid reaction; negative for albumin and sugar; microscopically showing many red blood cells, a few white blood cells and an occasional epithelial cell.

The urethral smear, on November 23, 1934, with the Loeffler and Gram stains showed gram negative, intracellular diplococci.

Operation. November 13, 1934. The preoperative diagnosis was acute appendicitis. On opening the abdomen a considerable quantity of serosanguinous fluid escaped from the peritoneal cavity. The cecum was found to be very much thickened, greatest in the outer and anterior surface and very dark in color. The discoloration, to a greater or lesser degree, involved practically the entire cecum, most intense in its anterior wall. The smaller blood vessels were seen to be full of blood clots. The appendix appeared perfectly normal and no other pathology was evidenced within the abdominal cavity.

Under ether anesthesia an incision was made to the right of the right rectus muscle. The lower right quadrant of the abdomen was carefully explored. The appendix was removed by first ligating the meso-appendix, cutting and tying the appendix off at its base, carefully carbolizing, but not inverting it. Then the cecum was dropped back into the peritoneal cavity and a cigarette drain was carried down to the surface of the cecum, and drawn out through the lower angle of the wound. The omentum was then placed carefully over the cecum to attempt establishing a communication between the blood vessels of the cecum and the vessels of the omentum. Then the abdomen was closed with drainage in the usual manner.

The patient was returned to his bed and for forty-eight hours an ice cap was placed over the incision. Enough morphine to control the pain and a hypodermoclysis of normal saline and glucose with nothing by mouth for twenty-four hours.

One cigarette drain was kept in the lower angle of the wound for four days.

Progress. The day following the operation the temperature reached its highest point of 101.8°F.; the pulse was 120 and respirations, 24. On the fourth postoperative day the temperature dropped to normal.

The patient was given an enema on the fourth day following operation. The next day he had a normal bowel movement but with considerable pain around the rectum and a small stain of bright red blood was noticed; examination revealed a fissure of the anus, with the bleeding apparently from that source. This slight bleeding occurred twice more while in the hospital, and once after returning home, each time after a difficult bowel movement. Treatment for the gonorrheal urethritis was started November 27, 1934. The progress was otherwise uneventful and the patient was discharged on December 3, 1934.

Follow-up. After discharge from the hospital the patient reported four times to the office merely to state that he was doing well. Examination January 29, 1935 showed the incision to be well healed, no hernia and no tenderness on deep pressure anywhere in the abdomen. Patient states he has no complaint and has a good appetite; for a while after leaving the hospital he noticed slight indigestion after each meal but is not noticeable now.

His normal weight is 155 pounds. He lost ten pounds while in the hospital; seven weeks after discharge he weighed 152. He returned to work December 18th, and is working full time at the same job he had before hospitalization. Since returning home he has had daily bowel movements, without the use of laxatives; he has no pain of any kind and no blood in the passage.

DISCUSSION

Before drawing comparisons the mechanism of such infarctions is considered first. To quote from Pendl,

On the basis of numerous observations in cadavers and experiments in animals (Kohnheim, Ziffer, Niederstein, Bolognesi, Merkel) we know that embolic and thrombic occlusion of the superior mesenteric artery induces complete cutting off of arterial blood supply from the region supplied by this artery, (small intestine and ascending colon) and that, in these regions, a more or less extensive hemorrhagic infarction (necrosis, and recurrent venous and arterial infiltration with blood) takes place. According to this, the superior mesenteric artery must be looked upon as an end artery, if not in an anatomic sense, at least in a functional one. Not only occlusion of the chief trunk but even a canalization disturbance in the medium sized and smaller arterial branches (Meier, Bolognesi) induces very severe nutritional disturbances in the intestinal wall. Such disturbances have been histologically analyzed by Pommer (Virch. Arch. cc). Death usually occurs under symptoms of grave peritonitis or ileus, combined eventually with colic and discharge of bloody stool (not always).

Cases in which there are said to have been no injurious results to the intestinal wall from such thrombosis of branches of the superior mesenteric artery must be evaluated most sceptically. A few exceptional cases do not change the anatomically determined fact that embolic and thrombic occlusion of the superior mesenteric artery or its branches usually has a fatal course. There are more than 150 cases of this sort reported in the literature. Attention should also be called to the fact that the intestinal wall will suffer the same injurious results in connection with primary thrombosis with occlusion of the mesenteric veins. A number of cases of this kind have also been reported to date. We should bear in mind however, that this thrombic occlusion of the mesenterial veins may also, in many cases, be the result of small arterial embolisms, in the mesenterial region (Merkel).

It should be noted that in this case apparently the location of the primary embolism was in the ileocecal artery but due to the large amount of hemorrhagic infiltration it is apparent that the corresponding veins were also involved.

In this connection it is well to refer to the investigations of Pommer, mentioned above. In a case of primary arterial occlusion of the superior mesenteric artery Pommer determined numerous phlebitic changes, similar to those described in Pendl's case. The phlebitic changes in his case therefor, do not prove that the affection occurred by the way of primary venous occlusion. There seems on the contrary, to be some reason for supposing that the hemorrhagic infarction of the segment of intestine was caused by primary occlusion of the ileo-colic artery. This assumption is based upon the sudden genesis of the affection in the right side of the abdomen and upon the distinct limitation of the changes to the cecum and ascending

colon with *exclusion of the ileum and appendix*. According to Fischer (Circulatory disturbances of the gastro-intestinal canal, Berlin, *Handb. d. Spez. Pathol. Anat. u. Histol.*, 1926), this can only be explained on the basis of the assumption that there were old adhesions of inflammatory character in the region of the appendix, thus affording a certain vascular supply to the appendix, in ways other than from the branches of the superior mesenteric artery. But this interpretation of Fischer's can hardly be accepted if we make a study of the distribution of the branches of the superior mesenteric artery.

According to Cunningham and Davis, Applied Anatomy, etc., such a study shows the terminal branches of the ileocolic artery to consist of (1) the colic, which supplies the first part of the ascending colon; (2) the ileal, supplying the terminal portion of the ileum; (3) the appendicular, supplying the appendix; and (4) the ileocecal, which splits immediately to form the anterior and posterior ileocecal branches, supplying the anterior and posterior walls of the cecum only.

Thus there are, anatomically speaking, three conditions from which thrombosis of the cecum can arise: (1) infarction of the superior mesenteric artery; (2) infarction of the ileocecal artery above the point of origin of the appendicular artery; (3) infarction of the ileocecal artery, below the point of origin of the appendicular artery.

So there is nothing to contradict the assumption that embolic or thrombic occlusion of the ileocecal artery, below the point of departure of the appendicular artery, may cause the changes in the cecum as have been described in this case, and that, as a matter of necessity, the appendix must be exempt from this infarction.

This assumption seems more reasonable to Pendl than an assumption of similar primary affection of the vein because he thinks that in the latter case the affection would be more diffuse in view of the more numerous anastomoses. In the left portions of the colon, approximately from the right third of the transverse colon to the rectum, grave hemorrhagic infarctions do not occur. This portion of the colon derives its blood supply from the inferior mesenteric artery which has generous anastomoses and functionally, does not behave like an end artery.

At this time it would be well to give a brief review of the 2 cases which have points of similarity with the one reported in this paper.

In 1929 Fritz Pendl reported a case of a man forty-one years of age who, unlike our case, had been suffering for six months from gastric disturbances accompanied by cramp like pains with constant twinging cramp like pains in the right lower quadrant when walking; on the morning of the operation, an egg shaped protrusion appeared in the region of the cecum, and a bloody stool was passed. Due to the painful tumor in the cecal region, the passage of a bloody stool on the preceeding night and the sudden occurrence of the last attack, a diagnosis was made of invagination of the ascending colon. No laboratory work was included in this report.

At operation:

The cecum was found to be swollen to the thickness of a man's arm; it was hard like a tumor and highly edematous, and showed deep dark red and bluish discoloration. The upper ascending colon was discolored and edematous, but not hard and tumor-like; it was soft and compressible. The peritoneum was shiny throughout; the ileum and appendix seemed to be entirely normal. The surgeon proceeded with the resection of the cecum, ascending colon, and a part of the transverse colon. Opening of the cecum disclosed nodular formations similar to potatoes emanating from the posterior wall; they had the appearance of tumors and toward the outside they protruded beyond the serosa; the intestine was filled with bloody stool. The tumor like welts were found by histological examination to consist wholly of intestinal wall in a state of hemorrhagic infarction; there were no symptoms of inflammation aside from the perivascular cellular infiltrations. The appendix was obliterated,

otherwise it was histologically unchanged. Recovery was disturbed by an abscess of the abdominal wall, but otherwise it was smooth, so that the patient was able to leave the sanatorium completely recovered at the end of 25 days. The macroscopic and microscopic findings showed distinctly that this was a case of hemorrhagic infarction of a limited segment of the intestine, i.e., of the cecum only.

In 1913 Bruns reported a case in which the vascular occlusion seemed to have developed a little higher, immediately above the point of departure of the appendicular artery. There was an attack of pain in the right side of the abdomen about three weeks before the patient came for treatment. The patient was a boy, age eleven years; here likwise there was nothing to indicate the cause of the vascular occlusion.

The literature contains a few cases of post-infectious suppurative thrombosis of the appendiceal region of which the following 3 reports are interesting, showing the contrast between suppurative thrombosis and the non-inflammatory type reported in this paper.

Fromme reports a case of operation upon the ileocolic vein for an infected thrombus causing hepatic abscesses, apparently the purulent thrombophlebitis originating from distinct purulent changes found at operation in the appendiceal mesenterolium.

Held and Goldbloom report a case of acute diffuse ascending inflammatory thrombophlebitis of the mesenteric veins, apparently starting in the region of the appendix; the diffuse hemorrhagic infarction involving the cecum, including most of the jejunum, and extending into the liver; and another case of inflammatory invasion of the appendiceal mesentery as well as infectious thrombosis of the ileocolic vein, causing suppuration of the liver with the production of jaundice, the portal system not being involved. This condition of "thrombophlebitis mesaraica," or mesenteric vein pyemia, usually spreads through the mesenteric or portal system and is rapidly fatal. In this case also the infection started in the appendix and quickly involved the mesenterolium.

From these instances it will be seen that the suppurative post-infectious cases of infarction can be eliminated from consideration in our case; and that Bruns' and Pendl's cases are the only ones reported with comparable pathology. Both of these cases were non-suppurative infarctions of the terminal branches of the ileocolic artery, but Bruns' case can be ruled out of comparison with the case reported in this paper because the appendix was involved in the thrombotic process, while Pendl's case and our case apparently had the infarction develop at approximately the same place in the ileocecal artery, i.e., below the point of origin of the appendicular artery.

It is important to note, however, that concerning the 2 case histories, there are major points of difference between Pendl's case and ours. The points of difference that render our case unique in surgical literature are:

(1) In our case there was a total lack of any previous history of illness; (2) the symptoms, even the blood count, closely simulated acute appendicitis; (3) the rapid, uneventful and complete recovery of the patient without resection of bowel which, however, may have been partly due to the early diagnosis of an acute abdomen and the early operation.

As to a possible cause of a thrombosis in this unusual location Pendl states;

> As yet no one has succeeded in finding a cause for the embolic or thrombic occlusion of this branch of the ileo-colic artery. According to Fischer the source of the embolism is thrombo-endocarditis, a cardiac thrombus, or an atheromatous process of the aorta. Up to the present, arteriosclerosis of the vessels has been assumed to be the cause of thrombic occlusion of the upper mesenteric artery in practically every instance. Turk reports a case of compression thrombosis of the superior mesenteric artery, due to lymphogranulomatosis. In Pendl's case, however, no affection

of the heart, the vascular system, or the lymphatic glands could be determined or even seemed probable. (This same holds true in Bruns' case and in our case.) After recovery from the intestinal affection the patient was perfectly well.

A possible clue to the etiology in our case would be the acute gonorrheal infection with the urethral discharge appearing four days before admission to the hospital. Since we exhausted all other possibilities in seeking to determine the cause of this thrombosis, we appealed to the Director of Venereal diseases of the Surgeon-General's office for aid. His report, which covered all the literature of the past fifteen years, contained notations of 4 cases of thrombosis occurring in unexpected vessels during the course of an acute gonorrheal discharge; however, none of these thromboses occurred in any of the branches of the superior mesenteric artery, and the supposition was left that the thromboses were incidental in the course of a common infection.

In our case, however, we think it is quite possible that the acute gonorrheal infection was the cause of the embolism. It is known that gonococci attack serous membranes and produce such clinical manifestations as arthritis, endocarditis or even septicemia; therefore it is reasonable to assume that a gonococcal embolus might attack the endothelium of isolated vessels. There is little evidence with which to support this claim, save as stated, all other possibilities had been exhausted. On the other hand there is little evidence with which to disprove this claim. Therefore we feel without being able to come to a final conclusion concerning the etiology, that not only possibly but also probably, the patient's acute gonorrheal infection was the cause of the appearance of the embolism.

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Surgeon-General's Index of 1933.

SPONTANEOUS RUPTURE OF UTERUS*

REPORT OF A CASE

OSCAR H. BLOOM, M.D.

Associate Obstetrician and Adjunct Gynecologist, Beth-El Hospital

BROOKLYN, NEW YORK

A SURVEY of the literature of ruptured uterus impresses one with the inadequacy of the etiological classifications of the traumatic and the spontaneous varieties. Paradoxically, the etiology for spontaneous rupture is stated among other causes, as (1) scars from previous Cesarean section; (2) malpositions and malpresentations resulting in forceful and prolonged labors, and (3) contracted pelvis.

Obviously, rupture of the uterus may occur from such factors, but one cannot conceive why these ruptures are classified as spontaneous, since the uterus is traumatized, in these instances, as much as one may expect in external trauma, in the ill advised use of pituitrin, or intra-uterine instrumentations. It is my opinion that the term "spontaneous" be reserved for the uterine rupture, resulting from intrinsic myometrial pathology, existing, unknown and unascertainable, by the obstretician. All other etiological factors which tend to strain the uterine musculature, whether internal or external, should be classified as subheadings of the traumatic variety. For example, the literature is replete with statistics showing the relation of contracted pelvis to the so-called spontaneous rupture. Lobenstine[1] reports 21 cases in a series of 46, Trask 74 cases in 417, Ames, quoted by Davis[2] 15 cases in 100, and many others too numerous to mention. It is ambiguous and contradictory to leave the reader with the impression that a rupture of the uterus caused by contracted pelvis and therefore avoidable, is spontaneous and hence, to a great extent, unrecognizable and inevitable. In the same vein, rupture of the uterus resulting from malposition and malpresentation, which gives rise to prolonged and forceful labors, should not and cannot logically be considered as spontaneous, because the obstetrician can and should terminate such labors, before rupture takes place. Therefore, spontaneous rupture should be defined as a rupture caused by an inherent pathological state of the myometrium, undeterminable prior to the rupture. The following therefore, are the true causes for spontaneous rupture: (1) degenerative changes in the myometrium, such as hyaline degeneration, hydatitiform infiltration of the muscle, or thinning of part of the uterine wall; (2) congenital hypoplasia of the uterus, and (3) congenital anomalies of the uterus, as uterus duplex or uterus unicornis.

Spontaneous rupture of the uterus may occur during any period of gestation and during the first or second stage of labor. Baisch[3] in 1903, reported 78 cases of spontaneous rupture, 31 of which occurred in the first five months of pregnancy. However, this condition is found more often in the later months of pregnancy. Multiparity seems to be a predisposing cause and reports from different clinics give ratios of 8:1, to 41:1. Lobenstine[1] assigns several reasons for this; (1) the general health of the multipara is not as good as that of the primipara, and (2) the uterine musculature is weakened in the multipara by (*a*) previous inflammatory disease or (*b*) scars from former incomplete tears. Kane[4] states that hyaline degeneration of the uterine muscle and intra-uterine manipulations in previous

* From the Obstetrical Service, Beth-El Hospital.

labors may possibly explain the increased frequency in multipara. However, in his cases, infantilism was found in every case of rupture in primipara. Generally, the etiology for spontaneous rupture may be stated to be due, in primipara, to some congenital defect in the development of the uterus, or as in case report of Richardson,[6] due to excessive invasion of the uterine wall by the fetal elements. Baisch described cases of early rupture in which the muscle was described as "paper-thin," due to hypodevelopment.

Spontaneous rupture may occur without any apparent cause. Ivanoff (Lobenstine[1]) examined 19 uteri microscopically and found himself unable to explain the etiology on the basis of pathologic findings, although he did find some considerable variation in the percentage of elastic fibers to connective tissue. Kleinertz (Davis[2]) also cites a case of a para xi, who had eight spontaneous deliveries and two abortions. The uterus, removed after rupture, showed no pathologic changes. Pride[8] and MacPherson[9] also report similar cases, while Baisch in his series of 78 cases, reported 9 such cases. Bauereisen (Davis[2]) observed telangiectic changes in the lower uterine segment and confirmed the findings of Ivanoff, the variation of the percentage of elastic fibers to connective tissue in the vicinity of the rupture. However, Horn (Shugt[10]) in his studies, has concluded that diminution of the elastic fibers and accumulation of fat in the connective tissue toward the end of pregnancy, are physiologic phenomena and do not explain the cause of rupture.

Ruptures of the uterus may be divided into complete and incomplete. By an incomplete rupture is meant the laceration of the uterine wall to, but not including, the serous coat. Two varieties of incomplete rupture are described, rupture of the lateral wall into the broad ligament but not involving the peritoneum; and the so-called peritoneal fissure of Sanger, which may occur in either the anterior or posterior wall. Needless to say, these lacerations are seldomly recognized and are of interest insofar that they may serve as a point of least resistance in a subsequent pregnancy. Complete ruptures may be either transverse or longitudinal, spontaneous ruptures usually giving rise to the latter type. Lobenstine in his 46 cases, found 26 longitudinal and 20 transverse tears; of the vertical type, there were 18 on the left side, 6 on the right, and 2 medial; of the transverse, 13 were on the anterior wall and 7 on the posterior wall. Savage (Lobenstine[1]) in 36 cases, reports 21 vertical and 15 transverse. In the transverse variety, the frequency is greater on the anterior than on the posterior wall. Pure fundal rupture is rare.

CASE REPORT*

A. F. Aged thirty-three years, an Italian housewife, was admitted in shock, at full term. Her past medical and surgical history obtained from her husband were negative.

She was gravida vii, para vi; no abortions either induced or spontaneous. All previous deliveries were spontaneous—a midwife officiating. All puerperia were normal and uneventful. Patient at full term.

On the morning of admission to the hospital, the patient experienced several moderately intense contractions, which subsided to such an extent that she was able to go shopping, from which she returned to her home at 10:30 A.M., no trauma or undue strain occasioned during her period of shopping. Shortly thereafter the patient began to have a recurrence of her contractions and sent for her midwife, in preparation for delivery. Suddenly she experienced a severe pain in her left side and fainted, followed by a gush of blood and amniotic fluid per vaginum. The midwife recognized an emergency and called a physician, who sent the patient to the hospital with a diagnosis of placenta previa. On admission, the patient was in shock and almost pulseless, and in spite of all temporary measures to relieve her shock, preparatory to operation, she expired.

Palpation of the abdomen revealed the classical signs of rupture of the uterus, the

* From the Obstetrical Service of Abraham Koplowitz, M.D.

fetal parts were palpated under the abdominal wall, cessation of uterine contractions, absence of fetal movements and fetal heart sounds and no presenting part palpated per vaginum. Our diagnosis of rupture of the uterus was made, but treatment was not continued because of the death of the patient.

At autopsy the abdomen was filled with clots of blood and amniotic fluid, the fetus was lying free in the abdomen, the uterus was contracted and over to the left side of the pelvis.

The uterus was 7 inches long, by 4½ inches at the fundus, and about 3 inches thick. No gross pathology was found to explain the rupture. The laceration was on the anterior wall, in the midline, in the upper segment only.

Microscopic examination of the uterine wall showed marked hyaline degeneration of the musculature, not only near the site of rupture, but throughout the organ.

SUMMARY

1. The present terminology is confusing.
2. The term "spontaneous" should be applied only to those cases of rupture, in which the pathology is unknown and undeterminable prior to the rupture.
3. A new classification of the spontaneous variety of uterine rupture is suggested, based on intrinsic myometrial pathology.

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WILM'S TUMOR*

DAVID N. INGRAM, M.D.

Surgical Staff, Canonsburg General Hospital

HOUSTON, PA.

A RATHER unusual case of a retroperitoneal tumor, is sufficiently interesting to be presented because of its histological structure. Dr. Ramsey reported that frozen sections showed the tumor to be a carcinoma and later sections confirmed the diagnosis of an adeno carcinoma. Further study revealed the presence of stroma or connective tissue cells, thus establishing the final classification of the tumor as a Wilm's tumor or adeno sarcoma.

In a search through the literature practically every conceivable type of sarcoma has been described as a primary tumor when found retroperitoneally, whereas carcinoma in this locality is considered only as a metastatic growth. However, Hansman and Budd[1] of Iowa City in 1932 report seventeen tumors similar to neoplasms arising in the adult urogenital tract and their conception is that these tumefactions arise from remnants of the urogenital apparatus and are therefore congenital in origin and develop by histogenesis. Judd and Lawrence[2] state that the so-called Wilms' tumor is the most frequent retroperitoneal tumor occurring in childhood. They quote Fraser as saying that this sarcoma in its early stages is, paradoxically enough, really a carcinoma, as its origin in the "renal rests" would indicate. With age, Fraser continues, metaplasia takes place giving rise to the sarcomatous characteristics usually noted. It is because of this Dr. Jekyl and Mr. Hyde or dual personality that we note the varied types of metastasis, by way of the lymphatics early and later by way of the Blood stream. In this case of a fifteen year old male, the rapid growth of the tumor, the age and the wide-spread and varied metastasis are manifested. I believe that the removed tissue showed an adeno carcinoma, the early stage of a rapidly growing Wilms' tumor with its origin in a "fetal rest."

J. B., fifteen year old male, presented himself complaining of a "Swelling above the right hip" which had first been noted about ten days before and which had been "getting bigger right along." About a month before this he states that his brother "bumped his right hip." Any trouble in this area previous to this was strenuously denied but he did admit that his "back had been sore at times" during the preceding month. There had been a considerable loss of weight during this time but no cough or night sweats had been present. His complaints also included shortness of breath, weakness and tachycardia upon exertion.

The family history reveals that the mother died eight years ago of pulmonary tuberculosis.

In his past history measles and mumps were the only diseases the patient had had. Although he was never a rugged child his habits were normal, he was a good student but did not enter into the more strenuous athletic activities.

On examination on admission to the Canonsburg General Hospital March 26, 1935, the lad was evidently quite ill, evidently in pain and his complexion was sallow. The heart rate was 104, blood pressure 106/72, but no cardiac pathology could be ascertained. At this time the lungs were resonant throughout and no rales were noted. Upon palpation of the abdomen a hard tense mass was found parallel to the crest of the ilium extending from the lumbar muscles posteriorly to the outer edge of the right rectus muscle anteriorly with a sense of fluctuation. Paracentesis of the mass yielded a sanguineous fluid containing large flecks of apparently purulent exudate which tended to

[1] Hansman and Judd, Massive Unattached Retroperitoneal Tumors. *J. A. M. A.*, (Jan. 12) 1932.

[2] Judd E. Starr and Lawrence. Abdominal tumors. *Surg. Clinics N. A.* (Aug.) 1932.

* Read before the Washington County Medical Society. Meeting September 11, 1935.

clog the needle. The mass itself was approximately 7 × 12 cm. evidently lying under the fascia of the external oblique muscle. Posteriorly, the lower thoracic and lumbar vertebra deviate in a gentle curve to the left, the maximum deviation being 4 cm. The spinous processes show no depression or kinking. On further palpation nothing was found in the pelvis nor was there enlargement in any of the solid viscera. The genitalia are normal, no enlargement or tenderness in either testis. Rectally, the prostate is small, soft and entirely normal.

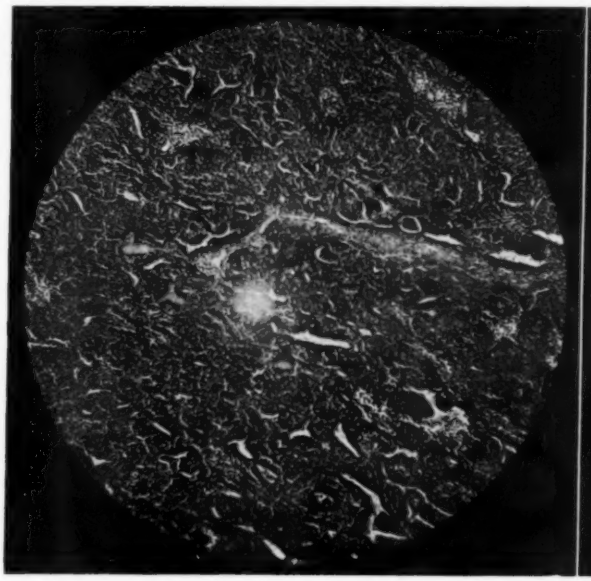

Fig. 1. Sarcomatous areas under low power.

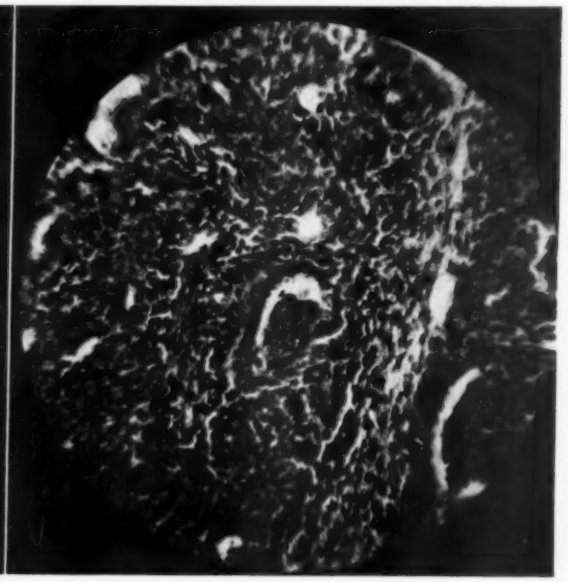

Fig. 2. High power magnifications of carcinomatous areas.

The impression at the time of examination was a tuberculosis of the right ilium with the formation of a tense cold abscess, a similar case having been observed on our service earlier. Other possibilities considered were vertebral caries and cold abscess, a pointing appendicial abscess, a pointing perirenal abscess possibly arising in the retroperitoneal lymph glands and lastly—I must confess only for the purpose of placing it on the record—malignancy.

The *x*-ray showed the ilium to be normal thus discounting our first impression of tuberculosis here. However, the body of the tenth lumbar vertebra was compressed somewhat and irregular in outline, suggesting caries at this point.

The urine was negative except for a high specific gravity of 1.032. Red blood cells numbered 5,900,000, and the white blood cells 12,800. The Kahn test was negative.

The next day under avertin-gas anaesthesia a typical gridiron incision was made and the tumor mass was encountered after the fibres of the internal oblique muscle had been divided. The parietal peritoneum had been displaced mesially and anteriorly and the mass was approximately 12 × 18 cm. at its greatest dimensions. Lying loosely between the fascial planes in every direction the appearance was that of glandular tissue. Extending from the lower pole of the right kidney it reached well into the false pelvis and impinged upon the anterior aspect of the transverse processes of the lumbar vertebra. Impossible of dissection or removal in its entirety the major portion of the mass was removed by digital morcellation, the cavity packed and wound closed with the tail of the packing acting as a drain. Needless to say, we regretted ever having opened the patient when the result of the frozen section was heard. On April 8 the patient was transferred to my "Courtesy Service" at Western Pennsylvania Hospital for maximal deep therapy radiation. By this time the involvement of the affected lumbar vertebra was decidedly increased and symptoms due to pressure on the sensory nerve trunks were quite pronounced by May 1st., when involvement of the liver and the lower lobe of the left Lung were readily discerned. On May 20, 2000 c.c. of sanguinous fluid, which on culture showed no bacterial growth, was aspirated from the left thoracic cavity to relieve respiratory and cardiac embarrassment. The liver metastasis grew rapidly until at the time of death on June 7, 1935 this organ was pal-

pated as a hard nodular mass extending down to the umbilicus. No regrowth at the site of the original tumor was noted. Death was due to the toxemia of the malignancy and not to any intercurrent infection.

DR. RAMSEY'S PRELIMINARY REPORT ON MARCH 28, 1935

The tumor is in fragments with friable partly necrotic tissue some of which is of a yellow color and has a fine honeycomb appearance. Other parts are grayish white, finely granular and have a malignant appearance.

Frozen sections of the grayish white areas show a malignant structure. The tumor cells are arranged in alveoli or tubular structure. The cells are highly anaplastic, growing rapidly and have many mitotic figures. The type of the tissue in other areas could not be definitely determined from the frozen sections. It is possible that the tumor is teratoid in origin with a one sided malignant development.

Diagnosis: Retroperitoneal carcinoma.

On April 3, Dr. Ramsey presented his final pathological report.

The gross specimen consists of a large amount of fragmented soft, friable tissue, portions of which are grayish white and the remainder is pale yellow and necrotic in appearance.

Microscopic examination of routine sections show a complicated structure. In some areas there is a marked tendency to papillary growth. In other places the new growth is almost diffuse and appears either as an alveolar or tubular structure with a minimum amount of delicate stroma. The tumor cells are deep staining and vary greatly in size and shape. The cells lining the papillary areas vary from cuboidal to columnar. In other regions the cells are polyhedral and sometimes spindle shaped. The cell cytoplasm in most areas is granular but there are numerous areas where the cell cytoplasm is clear. In the more malignant areas mitotic figures are numerous and the tumor is growing rapidly. Tubular structures frequently show papillary ingrowths. Many areas show the malignant cells to be large and flat resembling transitional epithelium. In some areas the tumor cells are very small, round or oval in shape. The tubular structures are frequently lined with columnar epithelial cells. Extensive areas of necrosis are present. In degenerating areas the stroma takes on a myxomatous character.

Further study of a large number of sections by Dr. Ramsey elicited the following supplementary report. In many areas the stroma of the tumor consists of thick spindle cells whose nuclei contain a rich deposit of chromatin and show many mitotic figures. These spindle cells are large, overnourished and have a malignant appearance. The tumor tissue therefore, contains two types of malignant tissue and since the epithelial structures are typically nephrogenic in origin the tumor belongs to the Wilm type.

Diagnosis:—Wilm's tumor.

SUMMARY

The interesting feature in this case is the notable predominance of tumor cells manifestly having their origin from epithelial tissue. The tumor unquestionably had its origin in renal tissue and inasmuch as the kidney itself was not involved it is my opinion that our tumor originated in a so-called "fetal rest."

PROLAPSE OF RECTUM

CAUSED BY EXTRAPERITONEAL CYST OF WOLFFIAN BODY ORIGIN

GEORGE I. ISRAEL, M.D.

Assistant Proctologist, Jewish Hospital;
Instructor in Anatomy, Jefferson Medical College

PHILADELPHIA, PA.

AN extraperitoneal cyst of Wolffian body origin was encountered during the course of an operation for prolapse of the rectum. Although there are numerous references made to retroperitoneal cysts of Wolffian origin, no reference was found to a case similar to the one reported.

Mrs. A. C., age forty-one years, married was first examined April 12, 1935 for a irreplaceable prolapse of the rectum with loss of control of the bowel movements. She was told by her parents that she had had a prolapse as an infant, but it gradually disappeared. After the birth of her first child twenty-one years previously, the prolapse recurred with loss of control of her bowel movements. The prolapse appeared with any moderate strain, such as standing, voiding or defecation but had been easily replaceable up to the present time. It had been necessary to wear a napkin all these years. She has had four pregnancies, each becoming more difficult because of increasing in size of the prolapse. Deliveries were technically very difficult.

On examination the prolapse was about 4½" in diameter with markedly relaxed sphincter ani. There was no rectal tear. For reduction of the complete prolapse of the rectum Moskowitz operation, obliterating the cul-de-sac, was considered the procedure of choice with a ventro fixation of the uterus and a perineorrhaphy with a possible plication of the sphincter ani.

The patient was admitted to the Jewish Hospital, Dr. S. L. Rubinsohn's service and operated April 24, 1935 under spinal anesthesia reinforced by ether. A paramedian incision was made. An extraperitoneal mass interposed between the bladder and the uterus and the adnexa presented itself after the belly was opened. The uterus and adnexa were adherent at various points to the rectum and portions of the sigmoid making numerous broad adhesions in the true and false pelvis. It was difficult to expose the cul-de-sac because of adhesions. A catheter was passed into the bladder to determine if there was a definite connection between the bladder and the mass. There was no connection. The mass, which was behind the bladder and covered by the peritoneum, was 4½ to 5 inches long, of irregular conical shape. The base was broad and was above the level of the bladder and overrode the bladder. The apex of the cyst was downward and to the left at the pelvic wall. The space of Retzius was entered to free this mass. A provisional diagnosis of cyst of the urachus was made. After complete walling off the wound, the cyst was incised and a heavy white gelatinous material was expressed. The apex of the cyst seemed at this time to become a fibrous cord and was lost deep in the pelvis. The peritoneum was closed and a complete extraperitoneal enucleation of the cyst was begun. The bladder was opened during the dissection of the cyst from its posterior wall. Lack of continuity between the mass and the bladder was confirmed when the bladder was examined from the inside. The bladder was repaired, the catheter being left in situ. A piece of iodoform gauze was placed in the space of Retzius and brought out at the lower angle of the wound which was then closed in the usual manner. We considered it good surgical judgment to discontinue additional surgery at this time.

The patient's recovery was uneventful except for incipient phlebitis of the left leg. Suprapubic drainage was stopped in eighteen to nineteen days. She was discharged on May 15, 1935, twenty-one days after operation. On discharge the patient had no prolapse of the rectum and control of bowel movements was satisfactory.

Pathological Report: by Dr. S. Levine of the Jewish Hospital.

Macroscopic. The gross specimen consists of an oval shaped cystic mass measuring 9 cm. in its longest diameter with a thick and leathery

wall. The internal aspect is studded with grayish placques. The cyst contains gelatinous material.

Microscopic. Section of the tissue shows it to be lined by degenerated columnar epithelium sharp line of demarcation. The subepithelial zone contains numerous bundles of smooth muscle, within which are large aggregations of polygonal cells with dark eccentrically located nuclei. The cells are arranged in linear bundles and are closely related to capillaries and blood vessels. A number of lymphocytes are also present. The cells mentioned are adrenal cortical rests, taking on the cellular arrangement of the stratum glomerulosium and stratum fasciculatum. This cyst is probably derived from the Wolffian body, and has no relation to a patent urachus.

Diagnosis: Urogenital Cyst.

Follow Up: The patient was seen five months after operation. She looked very well and stated that she had been feeling fine; has had no prolapse and has had control of bowel movements. About two months ago while scrubbing the floor, she felt a fullness in the rectum but no prolapse or escape of feces occurred. Examination revealed the abdominal wound in perfect condition, no hernia nor weakness. Rectal examination revealed a sphincter which was very easily distensible but retracted to normal shape. There was a definite loss of muscle tone and sphincteric action. There was a moderate bulge of mucosa seen through the protoscope. The patient was placed in a squatting position and no prolapse occurred.

I will briefly review the embryology* of the pelvic organs. About the end of the fourth week of embryonal life in the human being, the Wolffian bodies are formed along the sides in the lower third of the body, reaching upward to a point where the diaphragm develops and extending downward in the form of the Wolffian ducts to the cloaca. In the fifth to the sixth week of embryonal life, the elements of the primary genital gland covered with germinal epithelium appear just inside the Wolffian bodies. Coincidental with the development of the genital glands there are seen two ducts, situated externally to the Wolffian body, and which extend to the urogenital sinus, i.e., Mullerian ducts. The ovaries are developed from the primary genital glands and the remainder of the genital tract to the introitus is developed from the Mullerian ducts. The Mullerian ducts are at first solid and extend to the urogenital sinus as separate, unfused structures. Later, if the development proceeds normally, the Mullerian ducts run close together and the lower half eventually becomes merged into one structure. The upper part of this structure, the future uterus, acquires a lumen; the lower part remains solid for a longer time and gradually becomes the vagina. As the Mullerian ducts develop there is a corresponding retrogression of the Wolffian ducts, from the seventh to eighth week ending to the sixteenth week. Remnants give rise to pelvic tumors.

1. Parovarium
2. Gartner's duct.

*Graves Gynecology, 3rd Edition, page 470.

COMMENT

1. A congenital cyst of Wolffian body origin encountered in the course of an operation for prolapse of the rectum.

2. Prolapse of the rectum due to this cyst which by its position between the bladder and the uterus caused the uterus to evaginate into and prolapse the rectum outward at every stooping or straining posture.

3. Unusual position of this Wolffian body cyst, i.e., extraperitoneal between the bladder and the uterus.

4. Nature had attempted to obliterate the cul-de-sac by means of adhesions between the rectum sigmoid and adnexa.

5. Enucleation of the cyst resulted in a surgical and functional cure of the prolapse.

TRAUMATIC RUPTURE OF PENIS*

CASE REPORT

THEODORE R. FETTER, M.D. AND EDWARD GARTMAN, M.D.

Chief of Clinic Resident

Department of Urology, Jefferson Medical College Hospital, Service of Dr. David M. Davis

PHILADELPHIA

IT is a strange circumstance that unusual clinical entities have a tendency to occur in groups. Thus, on September 28, 1935, McKay and Hawes, of Charlotte, North Carolina[1] reported a case of traumatic rupture of the penis. On October 7, 1935, a similar case was seen in the Genito-Urinary Out-Patient Department of Jefferson Hospital. In more than a quarter of a century since January 1, 1910, when cross indexes of the records at Jefferson Hospital were started, up to November 1, 1935, there is not another instance of such a lesion in approximately 175,000 admissions. Moreover, in a period between January 1, 1926 and June 30, 1935, almost a full decade, only 10 reported cases of traumatic rupture of the penis could be found in all the medical literature. Because of the nature of the lesion, by virtue both of its rarity and of its location, it is apt to excite considerable interest and it is safe to assume that this number constitutes the greater part of those cases which have come to the attention of the medical profession in that period.

The etiologic factors involved in producing the lesion are self evident. Any blow to the erect penis sufficiently strong to counter balance the coefficient of its elasticity and the tensile strength of the viscus will produce the lesion. Previous infections or cyst formations[2] in the corpora cavernosa, which will reduce this already limited elasticity and tensile strength, may be considered predisposing factors. Although classically the lesion is said to be produced by the "faux pas de coit" of Guyon,[3] or by attempting to "break" a chordee with a sashweight, these agents are not recorded in any of the cases reviewed by us. Indeed, one is struck by the bizarre nature of the causative traumatisms, rolling over in bed,[1,4] accidently banging an erect penis against a toilet seat,[5] bumping into furniture in the dark,[6] and being catapulted against the dash board of a suddenly stopped automobile.[7] These are only some of the strange ways in which the penis has been ruptured.

The pathologic lesion consists primarily of a rupture in the penile fascia with hemorrhage and the formation of a hematoma. Usually one or both of the corpora cavernosa are torn and there may be involvement of corpus spongiosum and urethra. Although the latter complication, rupture of the urethra, is mentioned by every author, it is apparently rare. Only one instance in which it occurred could be found.[7] The hematoma may serve as a wedge between the two fragments of the torn corpus cavernosum and maintain the deformity. The diagnosis is obvious and usually easy.

The treatment instituted depends largely upon whether the urethra has been torn. If it has, there may be dysuria, hematuria, often acute retention and an occasional extravasation into the adjacent corpora. With involvement of the urethra the lesion immediately assumes grave proportions. A retention catheter should be passed at once and conservative measures followed until the edema, ecchymosis and pain have subsided and the extent of the laceration accurately determined. If, however, there has been an extravasation, there must be incision and drainage. The operative measures which must follow depend upon the

* Read before the Philadelphia Urological Society, December 16, 1935.

nature of the urethral tear and discussion of these procedures is not germane to this brief paper.

The simple laceration of one or both corpora cavernosa is treated first preferably by conservative measures, hot or cold compresses as is deemed expedient, support to the penis and scrotum and sedatives to allay the pain and obviate the possibility of erections. If the clot is not resolved in due time and the deviation persists, or the hematoma becomes infected and local suppuration occurs, it may be necessary to remove the clot. The possibility of the use of elastic splints has also been suggested, although, apparently no one has ever used them. The prognosis in uncomplicated cases is always good.

CASE REPORT

A. H., white, single, forty-eight years of age, a native of Turkey and a seaman, presented himself in the Genito-Urinary Department of the Curtis Clinic complaining of a swelling, bluish discoloration and a little pain in the penis, made worse by an erection. All of these symptoms had existed since early the previous morning. The patient's familial and personal medical histories are of no bearing upon the present instance. The patient states that he awoke Sunday morning, October 6, 1935, with a customary erection. The glans penis was caught in a fold of his sleeping garment, and, in effort to disengage the glans, the patient slapped his penis. He both felt and heard something snap, the sound being akin to that of a breaking bamboo stalk. This was followed immediately by moderate pain and considerable swelling of the penis. The patient consulted a physician at once, who, after assuring him that nothing serious had occurred, referred the patient to our Out-Patient Department. In the twenty-four hours between the occurrence of the traumatism and the time the patient was first seen in the Curtis Clinic, no urinary symptoms had developed.

The following day the penis was markedly edematous, diffusely ecchymotic and quite tender, but neither deformity nor blood clot was noted, and applications of hot saline compresses was advised. There was apparently no improvement and he was admitted to the Urologic Ward, October 14, 1935.

Physical examination was essentially negative, revealing a muscular, well built, middle aged white male in excellent health. The blood count and urinalysis were essentially normal; the Wassermann and Kahn tests were negative. His penis at this time was somewhat edematous and blotchily ecchymotic. On the right dorsolateral surface, at about the juncture of the proximal and middle thirds was a firm, slightly tender, almond shaped nodule about the size of a large lima bean. The shaft of the penis distal to the nodule was deviated to the left at a 45° angle. The patient was promptly put to bed, the penis and scrotum elevated upon an adhesive support and an ice cap applied. Sedation was freely administered, 120 grains sodium bromide daily and codeine and aspirin as required for pain; but these did not prevent matinal erections. Later lead water and laudanum compresses were substituted for the ice cap.

Under this regime the edema and ecchymosis subsided but the clot and angulation remained. Finally, on October 26, under gas anaesthesia, the clot was evacuated. A transverse laceration of the penile fascia and right corpus cavernosum was seen, the tear penetrating the corpus about 0.5 cm. and was about 2 cm. long. The penile fascia was sutured but the corpus was not, because the friability of that structure would not retain a suture very well, and the passage of a needle through tissue of such vascularity would only induce further bleeding. Furthermore, the deviation corrected and the interposed clot removed, it was assumed that union would take place and suturing unnecessary. Following operation, the penis was bathed continuously in hot dressings of a saturated solution of potassium permanganate. Convalescence was uneventful and the patient was discharged in nine days. At that time the wound was well healed and the deviation trifling. When last seen in the Out-Patient Department the deformity had virtually disappeared.

CONCLUSION

Because of the infrequency of this lesion, a case of traumatic rupture of the penis, the first seen in Jefferson Hospital in more than twenty-five years, is herein presented, together with a résumé of the treatment and clinical course.

[*For References see p.* 380.]

ACUTE OSTEOMYELITIS OF PATELLA*

MARIO E. STELLA, M.D.

Resident Orthopedic Surgeon, Kings County Hospital

BROOKLYN, N. Y.

A FEW cases of acute osteomyelitis of the patella have been reported recently and the literature reviewed. However, this present case is of interest because of an early diagnosis and excellent result, and may be added to the series of possibly no more than 50 recorded. According to all but one of previous records, diagnosis has not been made until actual septic arthritis has developed and the clinical course has been stormy and protracted.[1] Sinus formation and expulsion of sequestra have not infrequently occurred.[2] Consequently a satisfactory functional result has not been the rule. In one instance, the course assumed such chronicity, that it was difficult to differentiate from tuberculosis preoperatively.[3]

In the series of 51 cases, including his own, reported by Rocher, many were advanced cases necessitating arthrotomy of the knee and in 10 of these total patellectomy was performed.[4] It may be noted that complete and partial ankylosis, and loss of quadriceps power due to interference with the insertion of this muscle occurred in approximately one-third of these patients. In 6 patients ranging in age from five to thirteen years, following total patellectomy the patella regenerated completely. Apparently the patellar cartilage protecting the joint cavity as well as the fibrous periosteal envelope surrounding the knee cap had been spared. When the serious consequences of late recognition and treatment have been realized, it is well to keep this condition in mind in the differential diagnosis of infections involving the knee joint and its periarticular members.

The incidence of this important disease is rather small. Even authorities in the field of diseases of bones and joints either report a single case or none at all in their years of tremendous experience.[5,6,7] In standard textbooks of surgery the clinical entity is entirely disregarded.

It is found usually in children from five to fifteen years of age in whom development of circulation and ossification of this sesamoid are most rapid. Trauma apparently plays some part in lessening the resistance of the patella, but the origin in most cases is purely spontaneous.[4] There is a slight predeliction for males.

The chief complaint is pain about the knee joint which is aggravated by motion and most severe at night. In early uncomplicated cases motion is usually limited and painful to some extent, but in our patient it was entirely unrestricted and painless. The onset may be heralded by a chill and accompanied by elevation of temperature. Tenderness and swelling at first are localized over the patella and the normal depressions surrounding it are maintained. With progress of the illness, the swelling extends to the knee joint proper but the diagnosis should be established before this is advanced too far. In other words, drainage should have been instituted before the onset of frank septic arthritis when the prognosis becomes much less favorable. A synovitis is bound to occur invariably. During the first ten days this may only be a reaction to irritation in the vicinity but later the fluid becomes turbid, purulent, and organisms may be cultured. There is no fluctuation over the prepatellar bursa and no undue redness and tenderness of the overlying skin. Radiographic changes may be noted at this time, i.e., eight to ten days after the onset. Blood cultures

* From the Orthopedic Service of Dr. H. C. Fett, Kings County Hospital, Brooklyn, New York.

need not be positive. In the case reported at this time, the process was fairly well localized throughout the period of illness and the general condition of the patient was never alarming.

Fig. 1.

Fig. 2.

Case Report: On June 24, 1935, L. Di F. male, white, thirteen years of age was admitted to the Orthopedic service of Dr. H. C. Fett at the Kings County Hospital, complaining of pain in the left knee joint. The condition had started spontaneously three days previously and pain had been so severe at night as to keep patient awake. He had not been completely relieved by rest but motion aggravated his pain. On the day of admission he had a chill and felt feverish. His temperature at this time was 101°F. The remaining history was irrevelant.

We observed a healthy, well developed boy with abnormal findings only in his left knee. This region showed slight periarticular thickening and increased fluid with most of the swelling over the patella and just distal to it. The skin about the joint was discolored from applications of tincture of iodine. There was exquisite tenderness over the center and the lateral borders of the patella. The angle of greatest extention was 170° and that of greatest flexion 40°. Motion was slightly painful and there was no lateral instability.

Aspiration of the joint contents yielded 4 c.c. of clear yellow fluid which microscopically showed no increase in cell content and on culture demonstrated presence of Bacillus subtilis extraneous, evidently a contamination. The blood white cell count was 11,600 with 75 per cent polymorphonuclear leucocytes and the red cell count and hemoglobin were normal. The urine was normal, Wassermann negative and sedimentation time twelve minutes. At this time Buck's extension was applied to the leg and continuous hot soaks started.

An *x*-ray taken on June 27 was reported negative for osteomyelitis of the patella al-

though there was suspicion of roughing and destruction of the inferior pole. Conservative treatment was then continued with the thought in mind to institute drainage when necessary.

Pain persisted and swelling increased. On June 29 the fluid obtained on a repeated aspiration of the knee was cloudy and contained many pus cells. Culture of this material revealed presence of Staphylococcus aureus. The temperature fluctuated from 100° to 103°F., the pulse rate following accordingly. Blood culture had been negative persistently.

A roentgenogram taken on July 2 (Fig. 1) showed evidence of calcification and destruction in the patella interpreted at this time as the result of osteomyelitis. Some degree of effusion and infiltration in and about the knee was also demonstrable. That same day under inhalation anaesthesia a linear midline incision was made over the patella. The quadriceps tendon was stripped from the bone and on drilling holes into the patella, blood streaked with pus was evacuated. The soft necrotic bone was curetted and the saucer packed with vaseline gauze. No cast was applied, but the patient was again set in Buck's extension. Microscopic study of the sections of the material obtained at operation showed evidence of acute osteomyelitis of the patella.

The patient made an uneventful recovery. The temperature dropped to normal and remained flat. Discharge decreased and the wound granulated in. On July 24, a plaster bandage from the ankle to the groin was applied and the boy was discharged to the Out Patient Department. Sedimentation rate at this time was already normal. The cast was removed about one month later and the patient has had no further trouble. On Oct. 1, 1935 he had full range of motion of his knee but the operative wound, while not draining, had not as yet been completely covered with epithelium. An *x*-ray taken August 3, 1935 (Fig. 2) showed no evidence of destruction of the patella. The irregularity of the bone noted at this time is a temporary postoperative defect.

SUMMARY

1. Osteomyelitis of the patella is usually recognized rather late in its course when the indication is for more radical treatment and the prognosis for return of function is less favorable.

2. The salient points observed in the present case were: spontaneous onset of pain over the region of the patella, tenderness and swelling over this area, slight loss of motion at the knee and the symptoms of acute infection. Radiological findings became definitely positive about eight days after onset.

3. Diagnosis in this present instance was made early in the acute stage and a good anatomical and functional result obtained.

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DIVERTICULITIS OF ASCENDING COLON SIMULATING ACUTE APPENDICITIS

JOSEPH A. VISCONTI, M.D.

Associate in Surgery, N. Y. Post-Graduate Medical School and Hospital, Columbia University

HOBOKEN, N. J.

C. V., ten year old boy, was first seen July 24, 1935 because the previous night, he had had a sudden severe pain in the right lower quadrant causing him to double up. In several minutes the pain tapered down to a steady ache in the right lower quadrant, attended with tenderness over the site of complaint. There had been neither nausea nor vomiting. Bread and butter were the only foods ingested six hours prior to the onset. There had been no antecedent constipation. There was a past history of a similar attack exactly one year ago.

Initial examination disclosed persisting pain in the right lower quadrant attended with slight nausea. Little food or water was ingested since the onset. In lieu of a cathartic the parent prudently administered an enema with apparently good results, but with an aggravation of the pain. Physical examination elicited definite tenderness over McBurney's point.

He was returned to his home the following day. A blood count showed 8000 leucocytes and polymorphonuclear cells 69 per cent. Within twenty-four hours another count showed 9300 white blood cells with polymorphonuclears 73 per cent. Symptoms and signs continued without abatement though patient was ambulatory. Operation could no longer be deferred.

Operation. The abdomen was opened through a right rectus incision. The appendix was located and inspection revealed minimal congestion, insufficient to be considered responsible for the symptoms. It was removed and its stump treated to a Dawbarn inversion. Upon further exploration a half-inch teatlike process, that is best described as a miniature appendix was discovered about one inch above the ileocecal junction, on the anterior surface of the ascending colon, near the mesenteric border. Its base was of the same color, consistency and structure as the parent bowel with a discolored, almost black tip. In its gangrenous bulbous tip several fecoliths were palpated. The diverticulum was cut flush with the bowel and accorded the same treatment as the appendix. Dawbarn inversion completed the closure of the stump.

The ascending colon, transverse colon, and about twelve inches of the ileum were scrutinized for other diverticuli not one were found.

The pathological report confirmed the clinical diagnosis of gangrenous diverticulitis. It was of the true type in that all the intestinal coats were present.

The patient made an uneventful recovery.

CONCLUSIONS

While diverticulitis occurs chiefly in males over forty years of age, attacks in children are reported.

Diverticulitis is a disease of the left lower quadrant, but may occur anywhere in the colon, in fact anywhere from the eosophagus to the rectum.

A single diverticulum in the colon is not common.

The case presented bears out Kleb's contention that diverticuli occur at the mesenteric attachment where the intestinal wall is weakest but it does not necessarily exclude its presence elsewhere.

As in appendicitis, recovery from diverticulitis, without operative interference does occur. This is exactly what happened a year ago, as the history of the case reveals.

Appendicitis simulates many other intra-abdominal conditions and the converse holds equally true. It is reasonable to deduce that upon opening an abdomen, a questionable appendicitis ipso facto demands diligent search for simulating conditions that require surgery.

Experience has shown that whenever additional intra-abdominal search is warranted and undertaken, the operator will be rewarded for his vigilance in about 20 per cent of the cases.

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NEW INSTRUMENTS

INTESTINAL NEEDLES

G. A. HENDON, M.D., F.A.C.S.

Surgeon, St. Anthony's Hospital

LOUISVILLE, KENTUCKY

NEEDLES for suturing and holding peritoneal surfaces in contact have been made to meet the following requirements: (1) to avoid cutting blood vessels in their passage through the visceral structures; (2) to reduce to the minimum the size of the wound made by the passage of the needle in its progress, thereby limiting trauma; (3) to produce a wound conforming to the punctured type that has the faculty of closing in the wake of the producing agent; (4) to facilitate introduction by shapes that may readily be adapted to the contours of the surfaces to be approximated; for example, different degrees of curvature for concave surfaces and straight needles for convexities; (5) needles so equipped that the sutures may be attached in a manner that does not increase the size of the opening in the tissue beyond the diameter of the needle.

To approach as near as possible to the achievement of the ideal, some of these five points must be emphasized at the expense of others; this being one of those numerous refinements that belongs to personal tastes, judgment and complexities of the individual operator. There is only one phase, as far as I can see, that offers common ground for discussion. The needles equipped with attached sutures are selected quite properly to conform in diameter to the suture which they carry. This results in a slender needle that yields easily even to the slightest pressure, especially if it is curved.

Round or taper pointed needles have been used largely for intestinal surgery because of the desire to minimize the possibility of cutting capillaries; also, because of the belief that the intestinal tissues could be pierced readily by a taper point. It requires no stretch of the imagination to realize that more pushing power is required to transfix with a needle having a round point than one which presents even the minimum of cutting surface. I have found that appreciable resistance is encountered in piercing the walls of the stomach, especially when two layers are superimposed, even if one is the jejunum as in gastroenterostomy; also in suturing low, as in the sigmoid and rectum. Other examples are found in introducing sutures into the depths of some remote abdominal recess. Under the circumstances, I have often found that a needle with a round point becomes diverted when pushed into tissue; and, if not tightly clamped in the needle holder, may even make a complete revolution. In attempting to overcome these difficulties, the needle is bent out of shape which makes sewing with it increasingly difficult.

Therefore, I wrote to a manufacturer* about my troubles in this regard and suggested the feasibility of their supplying eyeless needles with a small cutting or bayonet point for intestinal suturing. This firm promptly and cheerfully gave me their cooperation by furnishing a generous supply of such needles, affixed

*Davis & Geck, Inc.

to sutures and having a cutting point according to my suggestion. The twenty day chromic catgut sutures are swaged into the hollow end of half-circle and 3/8 circle atraumatic needles having a special cutting point. This point has been so skillfully designed that it entirely eliminates the disadvantages of the triangular shaped cutting point common to the eyed surgical needles. These atraumatic needles produce a minimum of injury; and, since the cutting portion of the blade is on the under side of the needle, no additional trauma is created nor are blood vessels wounded when tension is placed on the tissues by pulling the needle upward.

Clinically, I have found these new atraumatic needles most satisfactory, entirely overcoming the obstacles mentioned and in no wise increasing the hemorrhage along the suture line. The needle goes through the tissues with the utmost ease, so that the surface contacts are made with greater rapidity and with more delicacy and accuracy than was possible with the round pointed variety of needle. When the task is completed, the needle does not resemble the scarred and distorted veteran of a conflict. This new cutting point atraumatic needle is a most useful contribution to the safety and speed of intestinal surgery.

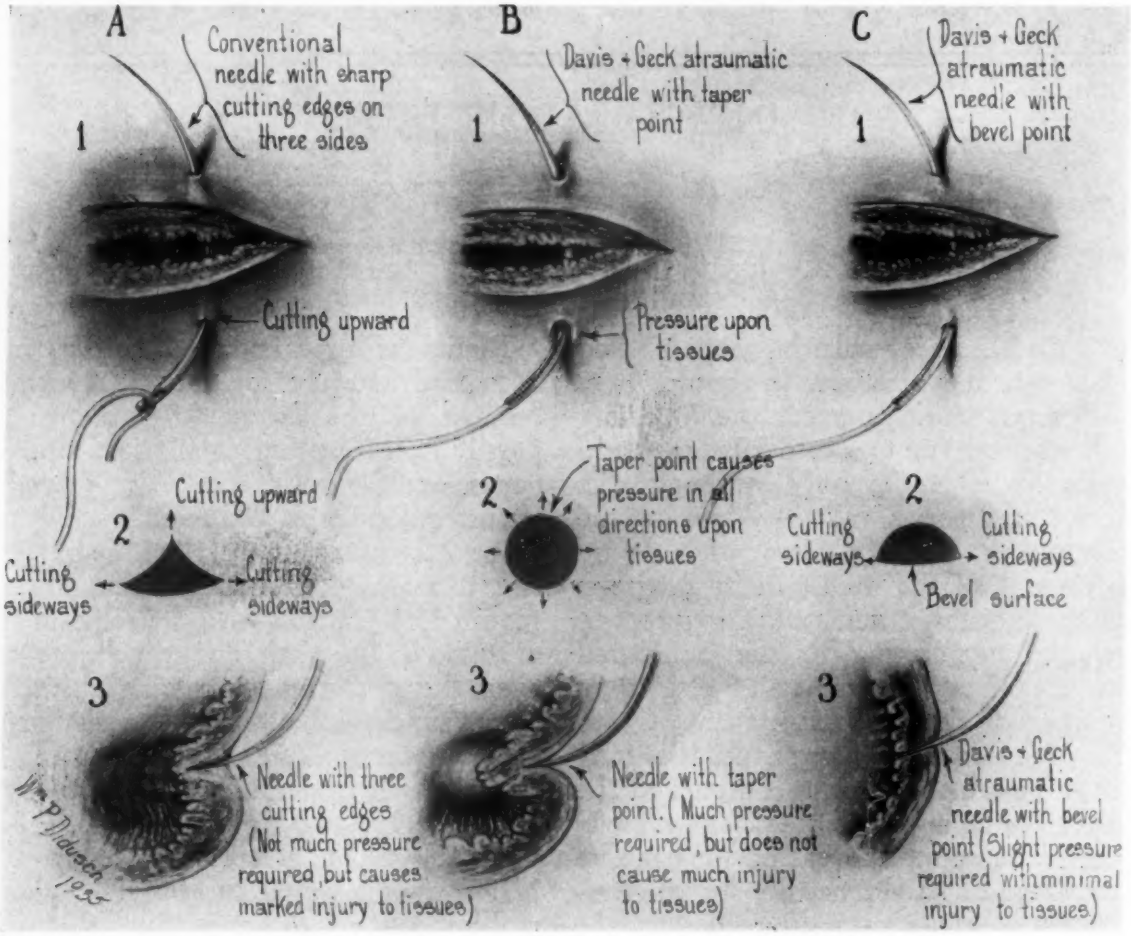

A
Conventional needle with sharp cutting edges on three sides
1
Cutting upward
Cutting upward
2
Cutting sideways
Cutting sideways
3
Needle with three cutting edges (Not much pressure required, but causes marked injury to tissues)
B
Davis + Geck atraumatic needle with taper point
1
Pressure upon tissues
Taper point causes pressure in all directions upon tissues
2
3
Needle with taper point. (Much pressure required, but does not cause much injury to tissues)
C
Davis + Geck atraumatic needle with bevel point
1
Cutting sideways
Cutting sideways
2
Bevel surface
3
Davis + Geck atraumatic needle with bevel point (Slight pressure required with minimal injury to tissues)

Fig. 1.

SILVER STAPLE CLAMP*

LESTER R. WHITAKER, M.D.

BOSTON

FOR years surgeons have known that metallic silver is remarkably well tolerated by the tissues. Silver wire in the form of a "clip" has long been used in neurological surgery to control hemorrhage and the bits of silver remain permanently without the slightest deleterious effect on either nerve or stroma.

There appears to be no contraindication to the general use of silver clips, at least where the field can be kept sterile. This includes the major part of surgery. Even the stone bearing gall bladder, if not grossly inflamed, is in most cases non-infective. One patient in whom silver clips were employed in the removal of a gall bladder containing stones has had no disturbance attributable to their presence for six years; and in more recent cases they have been well tolerated.

Even in infected tissues, silver wire apparently does not inhibit healing. In our laboratory dogs with infected wounds heal even though numerous silver clips have been placed therein. Postmortem examination reveals them solidly embedded in the scar.

The Cushing silver clip and its modifications, though beautifully effective in the brain, do not grip firmly enough for larger vessels in other regions where tissues are more resistant. The Cushing clip is a simple compressed fold of silver wire; apparently a double fold of wire in the form of a staple, similar to those for holding paper, would be more secure. A clamp for the application of silver staples is exhibited.

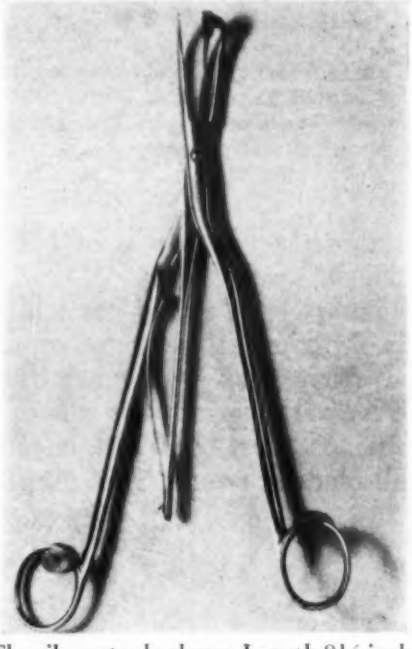


FIG. 1. The silver staple clamp. Length 8½ inches. The handles are adapted to fit the hand.

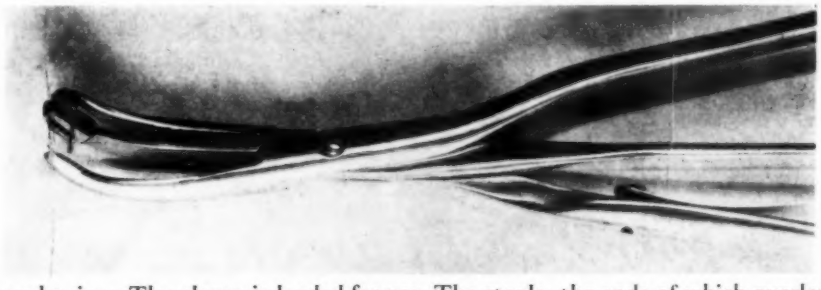
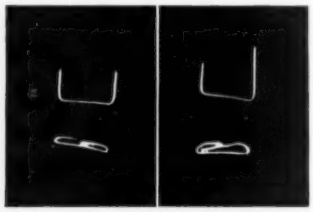


FIG. 2. Showing mechanism. The clamp is loaded for use. The staple, the ends of which overlap as in Fig. 3B, is shown here.

Owing to the thickness of the clamp at the end, it can not be used often in the ordinary way, by setting it into the tissues;

* From the Surgical Clinic of the Massachusetts Memorial Hospitals and the Evans Memorial, Boston, Massachusetts.

the vessel should be held with thumb forceps while the staple is accurately placed. Occasionally the staple can be applied directly to the tip of a bleeding vessel, as the cystic artery.



A B

FIG. 3. A and B. Silver staples of two types, before and after application. Actual size. The ends are cut to chisel points. When staples are closed the ends are folded in such a way that gauze will not catch on them.

This clamp was devised particularly for use in subperitoneal removal of the gall bladder from above downward, where definite vessel bearing strands of tissue are developed between the serosa and the gall-bladder wall. The staples can be applied effectively to these dissected strands of tissue. Time and trouble are thus saved by the avoidance of tying numerous vessels in a deep hole. It appears, also, that the silver staple clamp would be effective in surgery of the breast or thyroid gland.

A smaller and shorter clamp, with a different curvature of the jaws and carrying a smaller staple, could be made for use in neurological surgery where a more secure fixture than the ordinary single fold clip would be advantageous. Numerous adaptations are possible.

The staples are shaped on a special form and cut with a special chisel. By a slight modification the clamp may be made to apply a staple with which one end folds over the other (Fig. 3B) and which perhaps will hold more securely than the ordinary staple (Fig. 3A). Loading the clamp is done by the nurse, who, places the staple with pointed thumb forceps deep in the slot.

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* *Continued from p. 372.*

PROCTOSCOPIC ATTACHMENT FOR OPERATING ROOM TABLE

R. Russell Best, M.D., F.A.C.S.

Assistant Professor of Surgery, University of Nebraska Medical College

OMAHA, NEBRASKA

ALTHOUGH the knee-shoulder position is adequate for routine proctoscopy, it not infrequently proves awkward for both the patient and the doctor when the examination or operative procedure is prolonged. Even in this position, the end of the proctoscope near the examiner's eye will occasionally be lower than the end within the bowel, so that any retained enema solution or liquid secretion may run into the instrument and prove most annoying. For the weak, elderly or incapacitated patient and in operative work through the proctoscope, as obtaining a biopsy or removing a polyp, this position is especially fatiguing for both the patient and surgeon. The lithotomy and lateral positions are mentioned only to be condemned. In every instance, the most satisfactory position for proctoscopy is the inverted or Hanes' position.

There are proctoscopic tables ideal for the office but as they are designed solely for use in rectal procedures, their use in hospitals would require expenditure for a table unsuited for general operative work and a separate room for the table, unless it can be isolated in a corner of one of the operating rooms or the hallway. This expense and the additional space required are hardly warranted. Up to this time, no modification in these tables has been presented which will fill the general operating room requirements and still be advantageous for proctoscopic and rectal manipulations as the various positions required in general operative work have prevented the manufacture of a table with a hip break adaptable to the requirements of proctoscopy. With these factors in mind, I have designed an attachment for an operating table which in no way interferes with its general demands, and yet permits the patient to be placed in the inverted position for rectal procedures. This attachment should be used on tables which have a hydraulic pump control on the foot leaf.

Since all general operating tables are constructed with no break at the angle of the hip, the patient must be turned so that his head is toward the foot of the table. This brings the knee break at the correct place for the hip flexure and by lowering the foot leaf the patient can be placed in an inverted position. The referred attachment consists of a sheet of heavy metal molded to a right angle and attached to a pair of horizontal bars fitted with grips which fasten to the heavy side rails at the foot end of the operating table. The vertical portion of this metal sheet measures 15 inches in height and serves as the platform on which the head and elbows rest when the patient's body is flexed. The 7 inch horizontal metal sheet serves as a support for the horizontal bars. These heavy bars are 14 inches long and extend onto the vertical metal sheet for reinforcement. Bars of lighter metal angle across from the platform to the heavy horizontal bars for further support. There must be no cross bar support for a space of 7 inches between the horizontal bars at the table attachment end to allow for clearing the foot of the table and for adjustment according to the height of the patient.

After the attachment is secured to the foot of the operating table, a folded blanket is laid on the vertical platform and on this one or two pillows are placed. The usual table pad is used. The patient's head and elbows rest against the pillows and the

hands grasp the edge of the platform which has been protected by the blanket. By means of the hydraulic pump, the leg section of the table is gradually dropped and the patient's head gently lowered until he is in the inverted position. Since it is possible for the leg section of the table to descend too rapidly, it should always be supported to assure its lowering slowly. With the Scanlan-Balfour operating table, a fitting with check can be supplied which will prevent the too rapid lowering of the leg section of the table.

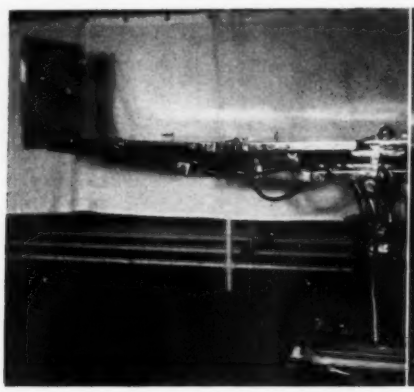

FIG. 1. The apparatus is attached to the foot end of the table.

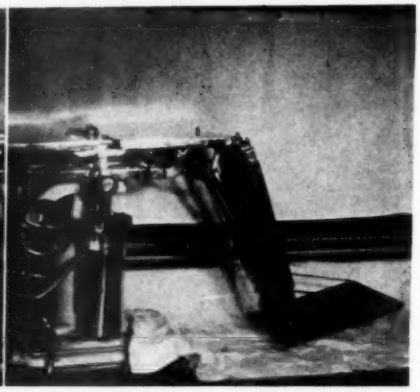

FIG. 2. The foot end is lowered and the patient's head and elbows rest on the platform.

After completion of the proctoscopic examination, the end of the table is elevated by means of the pump. If the examination is to be followed by any type of operative procedure in the prone, lithotomy or side position, the attachment is removed and the table pad and patient are rotated on the central axis of the table until the patient's head is at the usual head of the table.

This proctoscopic attachment has proved highly satisfactory as well as economical to us at the University Hospital and in several of the private institutions. The matter of strain on the table has been carefully discussed with manufacturers and the equipment has been endorsed.

CONCLUSIONS

1. A proctoscopic attachment for a general operating room table which will permit the patient to assume an inverted position had been presented.

2. By using such an attachment, expenditure for a special proctoscopic table is avoided and no additional space is needed.

3. This attachment has proved satisfactory and economical.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

TOBIAS SMOLLETT

CARL BECK, M.D.

BRIDGEPORT, CONN.

THE salty flavor of "Perigrine Pickle" ought to be acceptable to a generation of triumphant realism.

Smollett has come to his own. His knowledge of life and fierce energy should give him a high place among the realists. His was not the modern scientific method, characteristic of some of the leading novelists of our own day, but he was a great narrator, who told his story with zest and knew of what he wrote. His experience was extensive and he knew life as it was lived in Marshalsea and the Fleet, at Wapping and St. Giles, in the gaming houses of Covent Garden, in the bagnios of Longacre, with a knowledge that only a turnkey, a seaman, or a genius would have, but also with an understanding of a broad and generous mind. His was a bold and adventurous spirit that took him into the cockpit of a man-of-war, under the walls of Carthagena, in many an English wayside inn, in Jamaica, among the bleak hills of Piedmont, and this bold and adventurous spirit is reflected in his tales, as was all he saw and did and suffered.

Tobias Smollett was born in Dumbartonshire in 1721. His family was the most prominent in the district, the head being the novelist's grandfather, Sir James Smollett. Sir James was bred a lawyer in Edinburgh, represented Dumbarton in the old Scottish parliament in 1688, was Knighted by William III and was appointed to a judgeship. He was a zealous promoter of the union of England and Scotland and served on the Commission that framed the Articles of Union. Later he served in the British Parliament. The youngest of his children, Archibald, (there were four sons and two daughters) married without his father's consent, a young girl of no fortune. The old Knight settled on them the rent of a little property with an income of £200 a year. To the pair were born three children, Jane, James and Tobias.

Tobias attended the grammar school at Dumbarton, wrote verses which, like those of many another Scot, proclaimed the virtues of his native heath and the glories of Scotland. The pages of Buchanan's History gave him the inspiration for his Drama on James I, King of Scotland. At fifteen, he attended the University of Glasgow and for three years (1736–1739) fluttered about its cloisters. He took up his medical studies and was apprenticed to John Gordon, a well known surgeon of the city.

Glasgow had its group of intellectuals, a little knot of college professors, medical

men and clergymen. Hutcheson was then Professor of Moral Philosophy, and Robert Simson, the editor of Euclid, was Professor

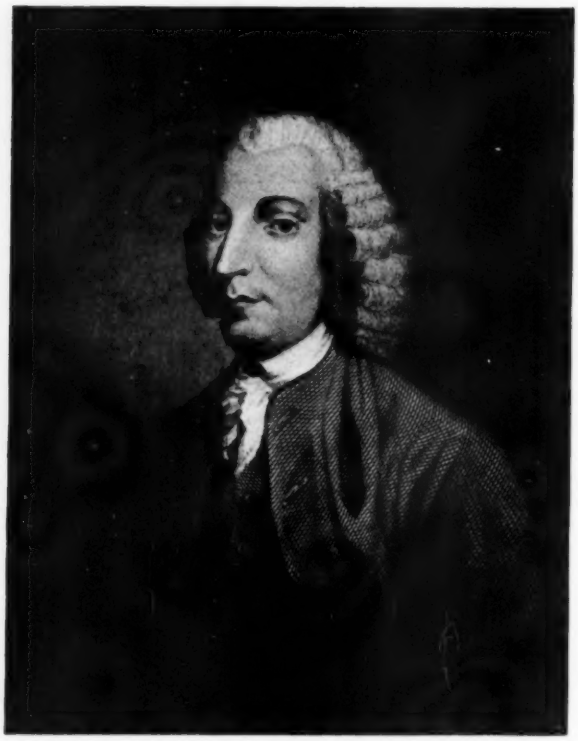

Fig. 1. Tobias Smollett, M.D.

of Mathematics. Among the younger men were William Cullen and William Hunter, the future chiefs of British medicine. About half of the professors were clergymen, and if any one had any doubts about Calvinism he kept them to himself.

Smollett was a rebel against the Presbyterianism of the time, a trait he doubtless inherited from his independent Scottish forbears, and never, to the end of his life, did he show any attachment to ecclesiastical forms. He began early to direct his shafts of satire against the money-making pride and religious fanaticism of Glasgow. It is significant that all literary men of the day were in this position of antagonism to theological dogmatism.

Smollett's friends procured him a position as surgeon's mate aboard a man-o'-war. His biographers report his embarkation in 1739 and do not report his return to England until 1744. We know he participated in the disastrous Carthagena Expedition in 1741. He served on one of the biggest ships of the squadron under Admiral Sir Chaloner Ogle joining Admiral Vinon's squadron in the West Indies, and was on his ship during the whole of the operations of the combined fleet and land forces against Carthagena. We gather that he cruised in these seas for the greater part of 1741 and resided for a time in Jamaica, where he became acquainted with a Miss Lascelles, a Creole beauty, daughter of an English planter. In 1744 he settled in London at the age of twenty-three, setting up his brass plate in Downing Street. He was rather more occupied with talking and writing than with attending the injured, the lame and the halt. It was when his affairs were at their worst that the Creole beauty arrived in London and after a while consented to marry him. In 1747, at the age of twenty-six, he was married and on the strength of his bride's possession of £3000 he took a new house. Unfortunately, the £3000 were not forthcoming, and it took an action at law against certain trustees to recover a portion of it.

Smollett turned to literature without giving up surgery and in 1748 he published "Roderick Random" in two small volumes. The story is in the main a burlesque autobiography and its success was greater than he anticipated.

As late as 1751, Smollett had not given up hope of reconciling literature with medicine. His medical degree he secured in 1749 from Marcschal College, Aberdeen, and he published about this time, "An Essay on the External Use of Water with Remarks upon the Method of Using the Mineral Waters of Bath." His writings show that the therapeutic use of water was a hobby with him, so that he is one of the forerunners of our modern hydrotherapy.

Had Smollett been a little active in soliciting a practice he might have succeeded, but he was indifferent, and his creative instinct was too much alive, so that "Dr. Smollett" turned more and more to literature.

The Peace of Aix-la-Chapelle opened up France to tourists and Smollett drifted to Paris and wrote "Peregrine Pickle." This novel was twice as long as his "Roderick Random" and had a rapid sale in both England and Scotland but what pleased its author most, was that it was translated into French.

By this time he had become a man of metropolitan note. He took a good house in Chelsea and was visited by many celebrities of the day and by a group of young literary aspirants who drew on the generosity of their amiable host.

In 1753 came his "Adventures of Ferdinand, Count Fathom." The ghastliness of the tale, which treats of a sort of "Jonathan Wild" of a high social strata had been preceded by Fielding's tale and resulted in its having but a short-lived popularity. In 1755 he translated "Don Quixote," published by subscription. Wearied by this task, he decided to visit Scotland and departed for Glasgow. He found his old master no longer a surgeon but a physician of high repute; one or two of his old professors were still alive and at the university; Cullen, not yet removed to Edinburgh filled one of the chairs in medicine. Hutcheson had been succeeded as Professor of Moral Philosophy by Adam Smith. He was welcomed by these distinguished men as one of themselves.

He returned to London and there began a new stage of his career. Baldwin, the bookseller of Paternoster Row, decided to issue a literary journal in opposition to the "Monthly Review." It was to be called the "Critical Review." The first number was issued in 1756. The same year Smollett edited for Dodsley a "Compendium of Authentic and Entertaining Voyages, digested in Chronological Series in seven volumes. In this "Compendium" he inserted several contributions of his own. In 1757 he wrote "The Reprisal of the Tars of Old England, A Comedy in Two Acts," and had the satisfaction of seeing it performed at Drury Lane. The play deals with the capture of an English yacht, aboard which was a young lady and a gentleman, by a French frigate and their ultimate rescue by a British man o' war.

David Hume was at this time laboriously occupied with his "History of Great Britain" and had completed two volumes. The work was proceeding slowly for Hume's efforts were palpably diminishing. The herculean task was accordingly undertaken by Smollett and in 1754, after fourteen months of unprecedented application, he gave to the world in four quarto volumes his "History of England from the Descent of Julius Caesar to the Treaty of Aix-la-Chapelle," containing the transactions of one thousand eight hundred and three years. He made no claim to the use of original documents but only as he himself put it to having presented to the public "a succinct, candid and complete history of England, more easy in the purchase, more agreeable in the perusal and less burdensome to the memory than any work of the same nature produced in these kingdoms."

In an action for libel against the printer instituted by Admiral Knowles, Smollett took the responsibility upon himself and in May, 1759, was fined £100 and sentenced to three months imprisonment. To pass the time pleasantly he wrote the "Adventures of Sir Launcelot Greaves," a travesty on Don Quixote, in which a young English gentleman is the hero, and which gave Smollett an opportunity to exhibit his gifts of social satire.

During the Bute ministry, Smollett edited the "Briton," an organ supporting his unpopular Scottish Prime Minister and his entire government. It was a trying time and before the ministry was over, Smollett broke down in health. He had been working also at his "Continuation of the History of England," a translation of the works of Voltaire in twenty-seven volumes and a compilation entitled, "The Present State of All Nations!" Finally the death of his only, beloved daughter completely prostrated him.

He crossed the channel to Boulogne in June, 1763, proceeded to Nice and resided there from November, 1763 to May, 1765. After an absence of two years he returned to England.

In 1766, an account of his wanderings in Europe appeared in his "Travels through France and Italy." It is written in the form of letters from Boulogne, Paris, Lyons, Montpelier and Nice to a friend in England. These "Travels" are interesting, make profitable reading and give more evidence of his medical knowledge than is to be found elsewhere.

After several months in London, tubercular symptoms again evidenced themselves and in addition he was troubled with rheumatism. He decided upon a journey to Scotland, arriving in Edinburgh in June, 1766. He sojourned here for several weeks, receiving friendly attention from Hume, Robertson, Adam Smith, as well as from Cullen and other luminaries of the medical world. Then he went to Glasgow, living for a time with his friend and biographer, Dr. Moore; thence he and a party of friends journeyed to the Vale of Leven, where he beheld for the last time the scenes of his boyhood. In August, 1766, he returned to England still an invalid and spent the winter at Bath. Here he rallied beyond the most sanguine hopes of his friends.

In 1769 he wrote his satire on public life in England, entitled "History of an Atom."

Smollett was slowly dying and his restless spirit and search for health took him in 1770 to Monte Nova near Leghorn. He was growing weaker and weaker yet the intervals of relief afforded him by the kindly climate of Italy, were spent in literary composition. This was "The Expedition of Humphrey Clinker." The manuscript was sent to London and there published in three small volumes. Soon afterwards he died in his fifty-first year.

After his death, his metrical satires, a metrical tragedy and other verse, published and unpublished, were gathered together and issued.

Three years after Smollett's death, a monument in his memory was erected on the banks of Leven near the house where he was born. The Latin inscription was furnished by Johnson. It is not pleasant to add that his widow seems to have been neglected by her Scotch relatives. She continued to live in Leghorn where she erected a monument over her husband's grave.

This background of biography will, I trust, make clearer the sources of Smollett's inspiration. Fielding, alone of his contemporaries, surpassed him in intellectual power and artistic skill, but Smollett surpassed them all in broad humor and sheer vividness.

II

The first of his novels "Roderick Random."

Notwithstanding the looseness of its construction, it may be considered his best. Fate had it that the tale, considered by many critics as the greatest in our literature, Fielding's "Tom Jones" should follow it. While "Roderick Random" suffers in comparison, it will hold its own with any other novel of its kind, contemporary or otherwise.

It presents the career of a friendless orphan exposed to the snares and pitfalls of a knavish world. The hero is not a gentleman, possesses no very high principles, and there is no pretense that he is one. The tale is picaresque, crowded with queer folk. The characterizations are consistent and the book is pervaded by a broad humor. He drew upon his experience as a surgeon on shipboard and his references to the life of the seaman are authentic and have the minute accuracy of a Dutch painting.

In "Roderick Random," Smollett exhibits in the highest degree all the qualities that made him famous. Here we find them in all their fullness—uproarious mirth, broad farce and broader humanity, truthful delineation and the keen zest for life he retained through all the years of

invalidism. Smollett created immortal English characters that have their counterpart in life. In Bowling we have the honest and manly English sailor, a character unmatched of its kind in all fiction; his hero Random is no mere paragon, he is flesh and blood, though a friendless orphan roaming through a hard world. Smollett would have detested the simpering perfections of the usual hero of fiction, untrue to life as untrue to art.

Perhaps the chief value lies in his authentic revelation of half-devils and half-heroes England has produced in such men as Benbow, Rodney and Hawke. Therein did Smollett render a great service to England and to English literature.

Smollett relies on the interest of pure action. His material is so picturesque, so romantic in the sense of being both strange and terrible that it gains, rather than loses, by his matter of fact treatment. There is no varnish of art in the description of Random's usage at the hands of a lawless crew and the brutal Cramphy on the grim Sussex shore. Here at least, he is supreme; in giving evidence of the truest artistic instinct, telling his tale with the utmost simplicity, with a precious artlessness. Nor is this all. There are quiet descriptions of events and things, full of movement and color—the Scotch parish school, the account of the fearful conspiracy of the boys aided and abetted by Lieutenant Bowling and Rory's coach trip to Bath with the intuition of carrying off an heiress. As in all, in these rollicking novels his gentlemen are ever ready with their swords and his common folk with their fists. Dumas himself, does not provide us with a greater variety of duels.

His humor is broad and infectious, it is that of the sea and the taproom without pretense of refinement and niceness but suited to his tales of the very human sturdy characters he portrays.

In "Perigrine Pickle" he gives us the story of a headstrong, unbridled and dissolute youth, who is wild at school, develops into an unprincipled man and is tamed only in prison. In this character somehow Smollett is able to suggest a capacity for profound love and higher things.

The novel is coarse, sometimes gratuitiously nasty and the author seems to revel in obscenity. But there is a fine spirit of farce and burlesque not characteristic of Roderick Random.

Gamaliel Pickle proposes to the lady of his choice in the terminology of the trades and with commercial curtness. "Madam, understanding you have a heart warranted sound, to be disposed, shall be willing to treat for said commodity upon reasonable terms." His descriptions of his characters tend to exaggeration—written in this spirit of farce. A physician spouts, "Greek and liberty." There is an entertainment given to a French Marquis, an Italian Count and a German Baron. The dishes served are of a horrible conglomeration, the guests maintaining a dignified reserve while undergoing the torture of the evening. Old Pickle and Commodore Trunnion dominated by their wives are treated in a like spirit. Smollett yields freely to his passion for caricature. The blasphemies are fearful, the humor always rollicking and coarse. Nowhere else is such a crew of originals brought together and so vigorously delineated.

In "The Adventures of Count Fathom" we have the career of a hideous and extraordinary scoundrel. Here is the same tendency toward exaggeration of incident and character.

His "Adventures of An Atom" has called forth the admiration of many readers, because of the remarkable gift for satire and allegory here shown. Reckless admirers have even compared him to Rabelais and Swift, but Smollett does not seem to be of the towering genius of these mighty giants of literature. The "Adventures of An Atom" is a political satire. Smollett is said to have been at first a Whig and turned Tory or vice versa and felt himself unduly neglected. The story is an incursion into mock history, extrava-

gant, full of wit and learning. An atom, wandering from Japan, becomes endowed with reason and speech, finds a lodgement in the brain of a one Nathaniel Peacock and causes him to write exactly what it dictates of past history. There are satirical comments on prominent Whig politicians and strange digressions touching upon all manner of things, giving evidence of the author's erudition.

"The Adventures of Humphrey Clinker" has throughout the air of a real diary. The acid, crabbed spinster Tabitha, Humphrey himself and his sweetheart are perfect of their kind and Lismahago, a sort of Scotch Don Quixote, is the glory of the whole company—a source of broad humor and farcical caricature. Some of the scenes are not surpassed for abandon and for the spirit of contempt for propriety and convention. The book is a miracle of rollicking filth.

Smollett made some attempts at the drama, but not very successful. But his "Regicide, A Tragedy" written at the age of nineteen, contains some good material. "The Reprisal" written at a later date is marked by his characteristic humor, in the burlesque presentation of the character of an Irishman, a Scotchman, a Frenchman and an English sailor.

The first biography of Tobias Smollett came from the pen of his friend, Dr. John Moore, which was followed by the Anderson biography and later one from the pen of Sir Walter Scott.

Scott gave his estimate of Smollett in the following words: "We readily grant to Smollett equal rank with his great rival Fielding, while we place both far above any of their successors in the same line of fictitious composition."

Smollett's letters are revealing. Those from abroad exhibit glimpses of the man at his best and they light up phases and objects with many vivid touches. A private letter written under date, London, May 8th, 1763, to one Richard Smith, an American colonial living at Burlington, New Jersey, is worth quoting as it helps considerably in understanding the personality of the writer.

"Sir: I am favored with yrs. of the 26th of February, and cannot but be pleased to find myself as a writer, so high in your esteem. The curiosity you express, with regard to the particulars of my life and the variety of situations in which I may have been, cannot be gratified within the compass of a letter. Besides there are some particulars of my life which it would ill become me to relate. The only similitude between the circumstances of my own fortune and those I have attributed to Roderick Random consists of my being born of a reputable family in Scotland, and my being bred a surgeon, and having served as a surgeon's mate on board a man-of-war, during the expedition to Carthagena. The low situations in which I have exhibited Roderick, I never experienced in my own person. I married very young, a native of Jamaica, a young lady well known and universally respected under the name of Miss Nancy Lascelles, and by her I enjoy a comfortable though moderate estate in that island. I practised surgery in London, after having improved myself by travelling in France and other foreign countries, till the year 1749, when I took my degree of Doctor of Medicine, and have lived ever since in Chelsea, (I hope) with credit and reputation.

No one knows better than Mr. Rivington (a friend of Richard Smith) what time I employed in writing the four first volumes of the "History of England"; and indeed the short period in which that work was finished appears almost incredible to myself, when I recollect that I turned over and consulted over 300 volumes in the course of my labour. Mr. Rivington likewise knows that I spent the best part of a year in revising, correcting and improving the quarto edition, which is now going to press, and will be continued in the same size to the late Peace. Whatever reputation I may have got by this work has been dearly purchased by the loss of health which I am of the opinion I will never retrieve. I am now going to the South of France, in order to try the efiects of that climate; and very probably I shall never return. I am much obliged to you for the hope you express that I have obtained some provision from His Majesty; but the truth is I have neither pension nor place nor am I of that disposition which can stoop to solicit either. I

have always piqued myself upon my independency and I trust in God I shall preserve it to my dying day.

Exclusive of some small detached performances I have published occasionally in papers and magazines, the following is a general list of my productions:

"Roderick Random," "The Regicide, a Tragedy," "A Translation of Gil Blas," "A Translation of Don Quixote," "An Essay Upon the External Use of Water," "Perigrine Pickle," "Ferdinand, Count Fathom," A great part of the "Critical Review," A very small part of the "Compendium of Voyages," The complete "History of England and Continuation," A small part of the "Modern Universal History," Some pieces in the British Magazine, comprehending the whole of Sir Launcelot Greaves, A small part of the "Translation of Voltaire's Works," including all the notes, historical and critical, to be found in that translation.

I am very much mortified to find it is believed in America that I have lent my name to Booksellers; that is a species of prostitution of which I am altogether incapable. I had engaged with Mr. Rivington, and made some progress in a work exhibiting the present state of the world; which work I shall finish if I recover my health. If you should see Mr. Rivington, please give my kindest compliments to him. Tell him I wish him all manner of happiness, tho' I have little to expect for my own share, having lost my only child, a fine girl of fifteen, whose death has overwhelmed myself and my wife with unutterable sorrow.

I have now complied with your request and beg, in my turn, you will recommend me to all my friends in America. I have endeavoured more than once to do the colonies some service; and am, Sir, your very humble servant,"

Ts. Smollett

This seems to me to be a manly forethought letter of a man of energy, essential dignity and character, which tells an interesting tale in itself.

Isaac Disraeli in his "Calamities of Authors" says, "Of most authors by profession, who has displayed a more fruitful genius and exercised a more intense industry than Smollett? But look into his life and enter into his feelings and we shall be shocked at the disparity of his situation and the genius of the man. His life was a succession of struggles, vexations, and disappointments—yet of success in his writings."

It is not surprising that under the circumstances Smollett was occasionally swayed by violent prejudices and permitted himself to give vent to injured pride. But "the battle over" says Thackeray, "he could do justice to the enemy with whom he had been so fiercely engaged and give a not-unfriendly grasp to the hand that had mauled him."

His best biographer and friend, Dr. Moore, pictures him from intimate knowledge "of a disposition so humane and generous that he was ever ready to serve the unfortunate. His passions were easily moved; he could not conceal his contempt and detestation of fraud, nor refrain from proclaiming his indignation against every instance of oppression."

His reward did not come in his own day. Such things are reserved for the warrior. That is the way of the mob. But the better minds of his own time and later generations have crowned him.

We know that Smollett shares with Fielding the honor of inspiring modern realism. Dickens in his early days sat at Smollett's feet. "Roderick Random" became the influence of David Copperfield. Our modern literature shows his influence.

Smollett's fame is secure and posterity pays tribute to his genius, his love of truth, his breadth of humanity, and his generous and independent spirit.

BOOK REVIEWS

A Textbook of Sterilization. By Weeden B. Underwood, B.S. in E.E. American Sterilizer Co., Erie, Pa., 2nd Edition, 1935.

This small book might well be in the sterilizating room of hospitals, or, at least, among the books on the shelf in the operating room supervisor's office. It is thorough and reliable.

The following are the subjects considered: The Destructive Factor in Steam is Temperature, Analysis of the Function of Steam in Sterilizing, The Hand Controlled Method of Eliminating Air and Condensate from the Sterilizing Chamber, The Thermostatic (Automatic) Method of Eliminating Air and Condensate from the Sterilizing Chamber, another chapter on the same "Controlled by Gauging Temperature of Discharge," The Disinfector Type Pressure Steam Sterilizer, The Drying of Dressings, Following Sterilization, and Explanation of Common Causes of Wet Dressings, The Pressure Steam Sterilizer for the Laboratory, Preparation of Materials for Sterilization and Methods of Loading Pressure Steam Sterilizers, Method of Testing the Performance of Pressure Steam Sterilizers, Preparation and Sterilization of Solutions, Water Sterilization, Sterilization of Instruments and Utensils by the Boiling Method, and Sanitary Protective Features.

The cost of this book is two dollars.

The Practioners Library of Medicine and Surgery. Volume IX. Neurology and Psychiatry. New York, D. Appleton-Century Company, 1936.

This volume on neurology and psychiatry has been prepared under the associate editorship of Dr. James C. Fox, Associate Clinical Professor of Neurology, and Dr. Clements C. Fry, Associate Professor of Psychiatry and Mental Hygiene, Yale University School of Medicine.

The book, consisting of 1234 pages, well bound and printed in large type, has been developed through the cooperation of thirty-nine individuals, who have prepared a total of forty-seven chapters dealing with special phases of neurology and psychiatry. All data has been classified and the chapters arranged as far as possible on an etiological basis, in this fashion departing from the accepted traditional methods of anatomical subdivision. The underlying pathology is stressed throughout the book. There is an attempted intimate correllation of the neurologic and psychiatric phases of each clinical condition discussed, rather than the sharp division into mental or organic classification.

The physician will find an unusual elaborate discussion of the modern concepts of psychopathology and psychoanalysis. The book is literally up to the minute, and although prepared obviously for the general practitioner, will be read with profit and general approval by the specialist in these diseases.

Diagnostic Roentgenology. By Ross Golden, M.D., Editor. New York, Edinburgh, Thomas Nelson and Sons, 1936.

This book of nearly 900 pages will appeal to the surgeon, the cardiologist, the urologist, the orthopedist, the obstetrician and the gynecologist as well as those known to the profession as roentgenologists. Fifteen leading men in their respective fields have contributed to the volume.

A copy of the Table of Contents is self-explanatory:

The Roentgen-Ray Diagnosis of Diseases of the Skull and Intracranial Contents, Cornelius G. Dyke.

The Roentgen-Ray Examination of the Paranasal Sinuses and the Mastoids, G. W. Grier.

Radiology of the Chest, Coleman B. Rabin.

Clinical Roentgenology of the Cardiovascular System, Hugo Roesler.

The Roentgen-Ray Examination of the Digestive Tract, Ross Golden.

The Roentgen-Ray Diagnosis of Diseases of Bones, Paul C. Hodges, D. B. Phemister and Alexander Brunschwig.

The Roentgen-Ray Diagnosis of Spinal Cord Tumors, Cornelius G. Dyke.

Roentgenologic Diagnosis of Diseases of the Urinary Tract, Leopold Jaches and Marcy L. Sussman.

Uterotubography, Samuel A. Robins and Albert A. Shapira.

The Use of the Roentgen Ray in Obstetrics, Howard C. Moloy and Paul C. Swenson.

The Radiology of Fractures, Edward H. Skinner.

The work is profusely illustrated. The Index is ample.

After perusing this book, one feels he has read something distinctly worthwhile when he has finished reading the chapter or sections in which his work and interests take him.